# THE STATE OF
# INDIA'S ENVIRONMENT
# 1984–85

## THE SECOND CITIZENS' REPORT

CENTRE FOR SCIENCE AND ENVIRONMENT

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# INDIA'S ENVIRONMENT
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CENTRE FOR SCIENCE AND ENVIRONMENT
NEW DELHI

**TO THE DAM-DISPLACED PEOPLE OF INDIA**

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The State of India's Environment – 1982
and is not a substitute for it.

The report has gone to print in various stages and several officials have since changed.
The Prime Minister referred to in the report is Mrs Indira Gandhi, except where stated otherwise

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**THE SECOND STATEMENT OF SHARED CONCERN**

This report is the result of the cooperative efforts of the following organisations: the Catalyst (Tamil Nadu); Centre for Education and Documentation (Maharashtra); Centre for Monitoring Indian Economy (Maharashtra); Centre for Science and Environment (New Delhi); Centre for Tribal Conscientisation (Maharashtra); Community Action for Development (Tamil Nadu); Dasohli Gram Swaraj Mandal (Uttar Pradesh); Environmental Services Group (New Delhi); Gandhi Peace Foundation (New Delhi); Hindu College Nature Club (New Delhi); India Development Service (Karnataka); Indian Social Institute (New Delhi) Kalpvriksha (New Delhi); Kerala Sastra Sahitya Parishad (Kerala); Lokayan (New Delhi); Manushi (New Delhi); Oxfam India (New Delhi); Parisar (Maharashtra); Patriotic and People-Oriented Science and Technology (Tamil Nadu); Sanctuary Magazine (Maharashtra); the Shahdol Group (Madhya Pradesh); Society for Participatory Research in Asia (New Delhi); Society for Promotion of Wastelands Development (New Delhi); and, Xavier Institute of Social Studies (Bihar).

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The report was edited by Anil Agarwal and Sunita Narain.

The work on the report was coordinated by Ravi Chopra until September 1983 and thereafter by Sunita Narain.

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The publisher and editors of this report are extremely grateful to the late Narottam Shah for all the encouragement and support he consistently gave them.

# INTRODUCTION

It is over two years that the first citizens' report on the State of India's Environment was released. Its reception was far beyond our expectations. We had been able to put the report together in just about five months. Information had come rolling in and as the trickle grew into a flood, the report in turn had grown from an intended 100-page monograph to a 200-page book. That fact had been an indicator to us of the growing nationwide concern over environmental deterioration.

But still the speed with which the concern was growing took us by surprise. Our report, having appeared at such an opportune time, was demanded and read far and wide by voluntary agencies, by social workers, in schools and colleges, by concerned government officials and agencies, by academics, and so on.

However, there seems to be another major factor behind the success of that report. In its own small way, the demand for the report confirms that Indians are really keen to know more about India and are starved for good information. Their two main sources of information at the moment are books and mass-circulated newspapers and periodicals. Newspapers and periodicals definitely play an admirable role in providing us with a daily, weekly or fortnightly, as the case may be, picture of the state of the nation. But there are several weaknesses in this picture: it is seldom more than a snap-shot; it is usually focussed on events and personalities; and, it usually — newspapers even more than periodicals — misses out the subtle and deep rooted processes that govern our social, economic and political development, until, of course, these processes emerge as crises. Often even when the crises are reported, the connections with the underlying processes are not made in any great detail.

There are indeed hundreds of books published every year which report and analyse these processes but having been written largely by academics, they tend to circulate within the already knowledgeable. Our report probably succeeded because it was timely; it was simple and readable; it brought processes and events together; and, it provided an overview instead of a snapshot. For many of us who are journalists and who had the opportunity to work on that report, it was a new kind of journalism and we were obviously gratified to see the response.

Our first print run was 3500 and it was sold out in about a year. That is, at a rate of about ten copies per day, including Sundays. Since then we have sold over half of our second print run of 2500. Numerous people have helped us in making these sales, notably Kamla Chowdhry of the Society for Promotion of Wastelands Development, Bittu Sahgal of Sanctuary Magazine, Chandi Prasad Bhatt of Dasholi Gram Swaraj Mandal, Dilnavaz Variava of the Bombay Natural History Society (BNHS), Kartikeya Sarabhai of Viksat, Cyrus Guzder of the Save Bombay Committee, Vijay Paranjpye and Ravi Bhagwat of Parisar, and Shekhar Singh of the Indian Institute of Public Administration. Several hundred copies have been distributed by us free, especially to poor voluntary agencies based in rural areas. Agencies like World Wildlife Fund (India), Society for Promotion of Wastelands Development, Consortium on Rural Technology, UNICEF, Oxfam and Bread for the World purchased nearly a thousand copies for free distribution. This helped us to get the book free to a range of worthwhile voluntary organisations and women's groups in the country.

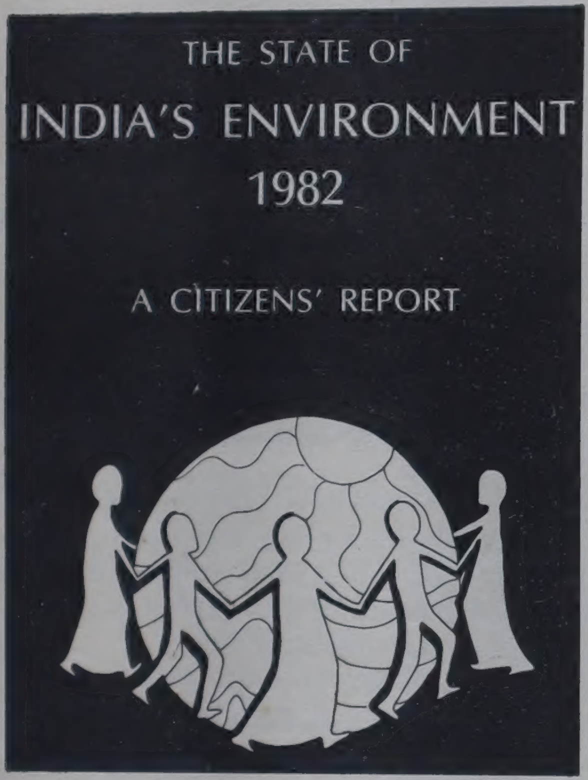
Responses from some readers were really touching. Having seen a copy of the report with Dilnavaz Variava of BNHS, Major Ian Grimwood, a retired British major now living in Kenya, purchased 20 copies for distribution to environmental magazines across the world so that they could review the report. A voluntary group in West Germany which used our report to set up an exhibition, later used the proceeds to purchase a hundred-odd copies of the English and Hindi editions for further distribution.

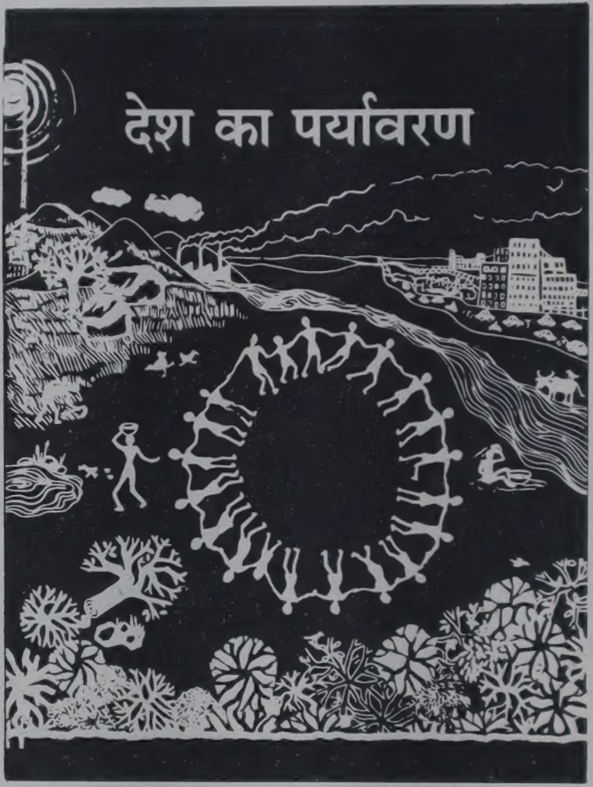
Responses from some readers were really heartening Narottam Shah of the Centre for Monitoring Indian Economy (CMIE), who soon became a fond critic and friend of our effort, purchased 250 reports for distribution to all his friends and subscribers of CMIE's publications.

Friends in the press went all out to help spread the word about the report. To name just a few: Dina Vakil arranged for a one and a half page spread in the Express Magazine. Suman Dubey arranged for a three-page review in India Today. Amrita Abraham in the Sunday Observer published a page full of extracts from the report. Claude Alvares wrote two long articles in the Deccan Herald. Darryl D'Monte wrote about the book in a number of publications. Krishna Raj provided enough space for two reviews in the Economic and Political Weekly and Rusi Engineer gave notice to it in Business India.

Friends abroad also went out of their way to review the report. John Gribbin of New Scientist did a seven page long cover story. Alice Barrass of the Economist published a rare two page review. Ignacy Sachs and Daniel Thery of the University of Paris took the initiative to write a full-page review in Le Monde. Harford Thomas, who writes a regular column on 'Alternatives' in The Guardian, London, intrigued us by describing the report as a model for the United Kingdom. Henrik Beer, a former secretary-general of the International League of Red Cross Societies, himself concerned by the fact that natural disasters and their impacts are growing across the world because of growing poverty and environmental destruction, making the traditional Red Cross work of distributing blankets and medicines more and more difficult and to some extent even irrelevant, convinced Dr Mostafa Tolba of the United Nations Environment Programme (UNEP) to distribute the report to various governments and environmental agencies across the world. UNEP presented copies of the report to all government delegations at its governing council meeting in 1983. The International Development Research Centre in Ottawa simultaneously purchased a hundred copies for distribution to universities and researchers in other developing countries, where foreign exchange restrictions posed problems.

However, the most important advantage of this sales strategy has been that it brought us in touch with numerous people across the country who are interested in environmental and social issues - a kind of network that we would not have built if we had taken a grant and then stored the report after publication. We attended several meetings organised by voluntary agencies and Vikasbhai a Varanasi based activist, organised a meeting of field workers in Sewapuri specifically to discuss the environmental issue.





But, all the kudos, readers in India and abroad and flow of funds would have been irrelevant, if the report was not able to reach readers in Indian languages. Even before the report was out, we had decided to make the report available to any voluntary agency in India for translation into any of the Indian languages free of royalties as long as no grant was taken to produce the translated version.

The response to translations has been overwhelming. Anupam Mishra of the environment cell of the Gandhi Peace Foundation (GPF) worked night after night aided by T.N. Atre and Dileep Chinchalkar to produce a Hindi version of the report by late 1983, which with additional material, took on a shape of its own. Famous Kannada playwright K.V. Subbanna, who runs Akshara Prakashana in Sagar had published the Kannada version by early 1984. The book was translated by Kannada's famous author and Bharatiya Gyanpith Award winner, Shivram Karanth and Saligram S.K. Four other agencies are currently working on translations into other Indian languages: the Kerala Sastra Sahitya Parishad (KSSP) on a Malayalam version; Parisar, Pune on a Marathi version; Cre A, Madras on a Tamil version; and, Oceanic Circle Trust, Rajkot on a Gujarati version.

These editions have helped us to take the report to people living in smaller towns -- a section of India's population that even the most successful books in English generally fail to reach, and which indeed would have been the fate of the English report on the State of India's Environment. The Hindi edition has been read avidly across the Hindi-speaking states by scores of social workers and interested individuals.

Our own experience with the English edition and the experience of other groups involved with Indian language editions has also taught us several hard lessons. To keep the price of the editions low, it has been important to publish them ourselves without entering the commercial publishing trade, in which the publisher and the retailer together tend to keep a 50-60 per cent margin at least. But publishing and marketing books is an extremely difficult, laborious, tedious and time-consuming task. Hours are spent just in the post office getting parcels registered. We at CSE have had to mail over 20,000 pamphlets to people in universities, schools and colleges, voluntary agencies, scientific institutions and government agencies to make them aware of the report. Ritu Menon, a friend who was till recently with Vikas, told us that this may be the biggest mail order campaign launched for any book in India. Both we at CSE and Anupam Mishra have had to learn the hard way the travails of becoming a one-book publisher.

Two of our collaborators in publishing the report in Indian languages — Cre A and Akshara Prakashana — are already socially motivated publishers. KSSP has a vast experience and network in publishing and distributing Malayalam books.

But our other collaborators who do not have this experience have faced difficulties. A few versions have even been delayed for this reason and some have just not taken off. We have had three separate individuals from IIT, Delhi, from Annamalai University and from Central Arid Zone Research Institute offering to translate the report into Telugu but none was in a position to take up its marketing and distribution.

One major lesson is that there is an urgent need today to develop an alternative, non-profit book publishing and distribution system. Such a system would help to keep prices low so that good literature can reach thousands of people at reasonable costs. Books have become so expensive that few people can now afford to buy them, making knowledge a commodity accessible only to the rich. Moreover, if such a nationwide book distribution system was available not only books would be cheaper but also public interest research could be undertaken without seeking and waiting for grants, as our experience with the

English edition shows.

The price of the English edition of the first report has been a subject of persistent debate amongst us and of lively discussions with friends and collaborators who felt the book was too expensive. We definitely share the view that a citizens' report must be as cheap as possible just as we share the view that such a book should not be financed through grants. When we had fixed its price at Rs 125 we had done so believing that this was the lowest possible price to make the project financially viable without any grants. We had tried to keep costs as low as possible; many CSE workers got their salaries months later and it took us a long time to pay our printing and paper bills. We were being chased for payments even six months after the publication of the book. But once the book was out we soon realised that the price of Rs 125 had fallen between two stools: it was too cheap for libraries and institutions when compared to the prevailing rates of books in the market and it was still expensive for individuals.

Because of the bulk purchases by Oxfam, Society for Promotion of Wastelands Development and other groups, we were sure that the report was reaching almost every worthwhile voluntary agency in India. But still it was true that we did not reach many individuals and students interested in the book.

However, we must also admit that in the long run, the price, high though it may be on certain considerations, has turned out to be exactly right for CSE: not too excessive and yet an unintended blessing.

The sales of the report together with the sales of the CSE features is currently about three-fourths of CSE's income. Because of the long time it has taken to produce the second report, the production of CSE features had to be stopped, which meant that we lost an important source of income. And because of the delay in the production of the second report — from an intended one year to over two years—the sales of the first report have had to carry the financial burden of the work all along. The sales of the first report have indeed done so admirably, far beyond our wildest dreams. Only towards the end of 1984, did CSE start facing serious cash flow problems: the sales of the first edition had started flagging whereas the second report was still not ready for sale. If the price of the first report had been any lower than what it was, the one year delay would have meant that the second report may probably have never seen the light of day. In this sense, that earlier price we had fixed was a blessing in disguise.

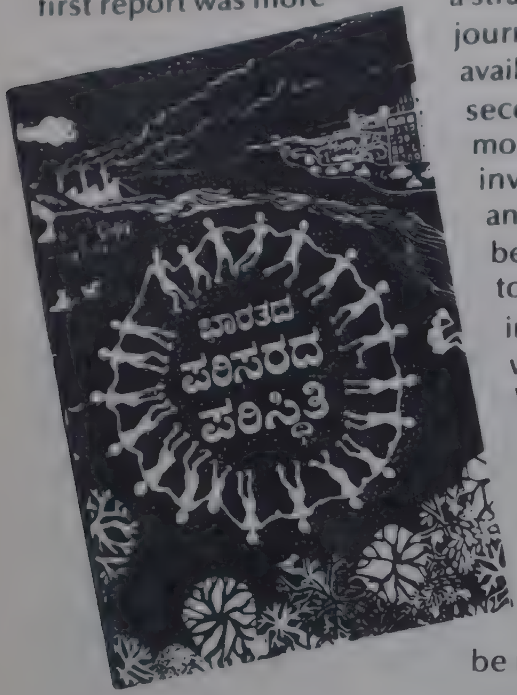
However, the report should be still more cheaply available to students and interested individuals and we have indeed agonised over this question a great deal. The simplest solution would be to produce hardback and paperback editions with differential prices: one price high for libraries and institutions and another very cheap for individuals and students. But not being an organised publisher, we face several difficulties with this strategy and a stark choice: how much of a publishing group do we become to remain a largely self-financing research organisation? Somewhere a happy medium has to be struck. The problem with the double-tier pricing structure is simply that we cannot rely on sales to libraries through a mail order campaign. Our last report was indeed purchased extensively by libraries. But this was probably because individuals found it difficult to buy the report themselves, and hence pushed their libraries or institutions to purchase the report. Our experience was that very few librarians themselves placed orders for the report. A mass mailing of our pamphlet to principals of colleges in India brought many orders but a similar mailing to librarians brought almost nothing. The book trade in India operates on a series of commissions which CSE cannot provide. If in such circumstances, a cheap edition, which was priced to bring in a return of only paper and printing costs, made it possible for many people to get personal copies, we are not sure if they would then put pressure on their libraries to order copies, making the entire scheme of doing research on a non-grant basis unviable.

Despite these fears, we have taken the plunge this time into a two tier pricing structure. There will be two editions of the second report: a hardback edition for Rs 320 which will be mainly for libraries and institutions and a subsidised paperback edition for individuals and students, whose price we have not fixed yet but which we hope to keep as low as possible depending on the sales of the hardback edition. Even before going to press we had started mailing pamphlets for the next report and a tally of about 700 orders had been recorded. We can only fervently request our readers to press every institution they work with to purchase institutional copies so that it becomes viable for us to provide cheap individual editions. To reduce the unit cost of the report, we are also going in for a highly ambitious print run of 10,000 copies.

The need for coming up with mechanisms that will permit groups like ours to remain largely independent of grants, not so much because of the strings with which they come but more because of the flexibility in operations that a regular flow of sales money brings with itself, is indeed urgent and important. And whereas we on one hand request the indulgence of our friends to bear with us as we blunder our way through to better solutions and mechanisms, we also need advice and support on how to come up with such systems.

Work on the preparation of the second report started effectively in mid-1983, nearly eight months after the first report had been published. It took us enormous time to set up a proper book despatch and accounting system, something that we in our naivete had never reckoned with while we were preparing the first report. It has taken us nearly 18 months to put the second report together and at times it has seemed like a long, tiring journey. What we had thought would finish in a year has stretched on and on into two long years. This delay was partly because of certain organisational difficulties, partly it was because of the nature of the second report, and partly because of the simple fact that it is almost twice the size of the last one.

The second report is not merely an update of the emerging environmental activities and concerns in India. It provides additional information on a number of subjects, which we could not deal with last time. The new report also presents detailed information on certain subjects which we had come to recognise as extremely important while preparing the first report, but on which very little information existed at that time. Information on nomads and grazing lands is not readily available. There are very few studies on the spectrum of occupational health problems in India; almost nothing is available on their trends. We had come to realise while writing our last report that there is a distinct relationship between women and their environment, and different from that of men, but there was again not much information available on this. Similarly, we didn't know much about, or even the significance of the consumption of firewood in towns and cities and its impact on forests. We have had to spend long periods collecting information on these subjects. In other words, whereas the first report was more a straightforward exercise in journalism, collating readily available information, the second report has edged us more towards an exercise in investigative journalism and research. And we believe that if we were to produce more reports in the future, this trend will come to dominate. Work will become more and more difficult but equally exciting – and it may not be possible to produce such reports every year. Once every two years may be more feasible.



The most interesting thing for us in the second report is the information that it provides on the linkages that operate on what can be called the interface areas: at the interfaces between different ecological spaces like croplands, grazing lands and forests; between the people and their environment; between economies of towns and villages, and so on. Very little is known about these relationships, especially as they relate to the people living at the margins of subsistence, and learning and writing about them has been extremely exciting for us. We have found that even many environmentalists lack knowledge of these relationships. For instance, a well-known campaigner on environmental issues in Madhya Pradesh recently wrote an angry letter to a newspaper urging the government to take strong action against the nomadic tribes coming in from Rajasthan. We on the other hand, looking at the problem the point of view of the nomadic people found that they are less destroyers of the environment and more victims of development.

We now believe that if for anything, this series of state of environment reports needs to be continued, it should be to collect more and more information on these interfaces. Indeed ecology is all about relationships in nature and sustainable development will never be possible unless we know more about the true relationships between changing nature and changing society. By the time we come to the end of one report, we become aware of new relationships which need to be analysed in future reports. One that we can point out right now is the displacement effect of development activities, which mainly end up benefiting the urban population while adversely affecting the rural populations, driving more and more ecological refugees from the rural areas into the towns and cities, where they are then met with increasingly hostile laws.

There was some criticism of the first report that it did not present alternatives or guidelines for action. This criticism came from some government officials and from some voluntary agencies and individuals. We believe that this criticism is very valid but a bit misplaced because it does not seem to take voluntary activities, which we had taken great care to describe in detail wherever possible, as indicators of alternative action and approaches.

Still when we began writing the second report, we had hoped to focus on alternative strategies as much as we could. But as we got more into the writing and preparation of the second report, we found this extremely difficult because of the paucity of alternative thinking. Ironically, as we learnt more about the relationships between environment, economy and society, we began to see the irrelevance and even negative impact of solutions being suggested with such great alacrity. For instance, at a time when India's grazing lands are rapidly decreasing and deteriorating and there is an acute fodder crisis, it looked

### The Work Beyond Publishing

The work on the Hindi State of the Environment Report started (Desh Ka Paryavaran) almost the same way as the work on the English SOE. No colleague was free in the Gandhi Peace Foundation to work on the translation of the report and the organisation did not have any money to spend under this head either. But it was agreed that a Hindi version of the SOE would somehow be produced.

Our elder colleague T.N. Atre, who lives 70 km away in village Samalkha in Haryana and comes two days a week to Delhi to help us in our work, did not have any direct experience with environmental work nor had he ever attempted to translate such a large book. But having read the English SOE, he felt that translating this report was probably the most interesting and useful work he could do. In this way, the translation work began in December, '82 with no money but a great deal of enthusiasm and committment. Editing work was also taken up simultaneously.

The response from friends was equally enthusiastic. As the word began to spread that a report on the State of India's Environment is also going to be printed in Hindi, some 80 advance orders rolled in, even without any publicity. Because of the enthusiasm shown by these organisations and individuals, we decided to rethink our printing plans. Afraid of the large expenditures involved, we had earlier decided to go in for hand composing and letterpress printing. But we now decided in favour of photocomposing and offset printing even though we were not in a position to pay the prevailing commercial photocomposing rates. Fortunately, a friend agreed to take up the work at cost price. By the time the Hindi manuscript was ready we had already received 200 advance orders and by the time the book was printed we had sold 900 copies. Because of this snowballing interest, we increased our original print order of 1100 to 2200.

Even as the matter was being sent to the press, we kept on including additional material and illustrations on environmental problems from Hindi-speaking areas of Madhya Pradesh, Uttar Pradesh, Rajasthan and Bihar. In this work, we got help from numerous environmental activists, journalists and Hindi newspapers.

The selling of the Hindi SOE has been an experience itself. This exercise helped us to come in touch with innumerable people and institutions and greatly expanded our network. Several big and small institutions and action groups joined hands to sell the report. Though the printed price of the book was Rs 100, most of these institutions were sold the report for Rs 60 and in some cases even Rs 50. By selling the book at the printed price, these organisations were able to make some small savings for their field work. A small organisation in Madhya Pradesh even took an interest-free loan from a friend to more and more hypocritical (or downright stupid) of Indian foresters and the World Bank to make such tall claims about planting millions of non-browsable eucalyptus trees.

If there is any conclusion we have reached, it is that so-called experts know extremely little about the lives of the people living at the margins of subsistence and how they are being squeezed by modernisation ad development. The major contribution that a report like this one, or ones in the future, can make is to increase this understanding so that truly sensible alternatives can be found. This report, for instance, makes it very clear that unless there is a holistic thinking about the management of India's environment and unless women become centrally involved in environmental management programmes, success will be impossible or short-lived or simply a fraudulent propaganda exercise.

We have come to believe strongly that these reports are indeed in an excellent position to further these understandings. This is simply because voluntary agencies have a far better understanding of the people living at the margins of subsistence than government agencies or the erudite academic world. Their nearness to the grassroots and, even more their action programmes (because knowledge is essentially generated out of action and experience), put them in the most appropriate position to undergo the learning process needed to understand the poor and powerless. For instance, it is not any intellectual depth but an honesty of purpose and committed action that has made the Chipko volunteers realise the crucial importance of women in environmental action. We, of course, as individuals are extremely grateful to all such individuals and agencies who have given us this extraordinary opportunity to understand our country better and document and communicate their experiences to a wide range of people.

As was the case with the first report, this report too is the result of active collaboration and support from several

purchase Hindi SOE copies. The immediate payment helped us and by selling these later, this group not only paid back the loan but it also saved something for its own work. Meanwhile, several national and state level organisations helped us to arrange or pay for sponsored copies. This helped us to get the SOE as a gift copy across to almost every good environmental activist and organisation.

We also decided to gift copies to selected journalists in the Hindi media. We plodded through back issues of newspapers and magazines to identify journalists who had filed interesting reports on environmental issues. It was then that we noticed that in several Hindi newspapers, particularly those of Madhya Pradesh, several readers had been regularly sending in new information and incisive comments on environmental problems in their own local and occasionally even distant regions. This information was being published in the 'letters to the editor' columns. We decided to identify such readers and gift them a copy of SOE. The readers were chosen keeping in mind the regularity with which they had written, the places where they came from and the issues they addressed. We tried to know more about these people by writing letters to them and even after sending them a gift copy, we have tried our best to keep in touch with them. One result of this exercise is that a reader in Shajapur, a small town in Madhya Pradesh, after receiving a copy of the SOE, started a local group to address local environmental problems.

Because of the interest and enthusiasm with which the Hindi SOE was being read, we also felt that any income from the report ought to be invested on environmental action work. Because our organisation takes care of our salaries and other expenses, we did not want to convert the income from one book into another book. We wanted this money to go back to support work being done in the field. The Gandhian Academy of Studies based in Hyderabad also came forward to help us in the organisation of ecodevelopment camps using the Hindi SOE as their base document.

Over the last six months, several action groups have organised one day to seven day camps in not only Hindi speaking areas like Madhya Pradesh, Uttar Pradesh and Bihar but also in non-Hindi speaking areas of Karnataka and Maharashtra. Some 14 camps in all have already been organised:

* by Gandhi Peace Foundation for social and development activists in New Delhi;
* by Goa Lok Samiti for rural development workers of Goa, Karnataka, Kerala and Maharastra;
* by Aanter Bhariti in Ratlam in which environmental problems in Ratlam were discussed;
* by Jan Paryavaran Manch, Prakriti Sangh Abhyas Mandal and Gandhi Peace Foundation in Indore to discuss the environmental problems of the city and the pollution of the Khan river;
* by Mitti Bachao Abhiyan in Hoshangabad to organise a one day meeting and farmers' rally;
* by local action groups in Singhbhum;
* by Gandhi Peace Foundation for Hindi newspaper journalists in New Delhi;
* by Chattra Sangharsh Vahini in Almora;
* by Lok Chetna Manch in Ranikhet;
* by Dasohli Gram Swarajya Mandal in Bached village, Chamoli;
* by the Appiko movement in Sirsi;
* by the Transnational Centre for Non-Violent Social Change in Dharwad to protest the pollution of the Tungabhadra by Harihar Polyfibres;
* by Wardha Nisarg Mandal in Wardha; and,
* by Gandhi Peace Foundation involving small environmental action groups from all over the country in New Delhi.

The main objectives of these camps have been to help consolidate the work that is already being undertaken and, in those places, where problems exist but no environmental action has started, they make a small attempt to initiate a beginning. For instance, a public sector alcohol plant in Ratlam is a major cause of air and water pollution in the town. We had published some information on this problem in the Hindi SOE. A local organisation working with local youth became interested in raising it. A camp was held in which social workers, interested scientists and representatives from 17 affected villages came together to decide on concrete action. The camp helped the organisation to see environmental problems in the wider context of development and to appreciate how these problems affect a large population in the country. The organisation resolved to stop all its existing activities for one year and concentrate only on local environmental problems. Another camp was held in Wardha to bring together environmental activists from the Vidarbha region to focus on select environmental issues.

The Ganga Mukti Andolan in Bhagalpur has come to see environmental problems in the light of the livelihood of fisherfolk and farmers and the threats to it. So that this consciousness can also reach other organisations working along the Ganga river, the Ganga Mukti Andolan plans to get in touch with these groups at five to six different places from Kahalgaon (in Bhagalpur, Bihar) to the upstream city of Varanasi. This work will also be a part of this series of ecodevelopment camps.

Not only Hindi but also a number of Gujarati and Marathi news papers have helped us to spread information about the report by publishing detailed reviews. As a non-commercial publication, the report could not have reached many distant places without this support.

ANUPAM MISHRA

individuals and voluntary agencies across the country. To name just a few individuals:

- Sevanti Ninan travelled to Madhya Pradesh, talked to dozens of people and plodded through a huge pile of documents to write the report on social forestry.
- Balraj Kumar travelled to Rajasthan to talk personally to people displaced by the Pong dam, and to Haryana and Uttar Pradesh to find out how cowdung and crop wastes, important sources of fuel for the poor, are being steadily commercialised.
- Ravi Chopra and Sunita Narain went to Bastar to do a first hand report on the state of its forests and tribals and came back with disturbing news about a series of proposed dams on the Indravati.
- Ramesh Awasthi travelled to nearly a dozen places to talk to people fighting against the construction of dams or for adequate and appropriate compensation for lands lost to dams.
- Sunita Narain went to Vedchhi in Gujarat and Priya Deshingkar to Dharwad in Karnataka to watch the mobilisation of the people by voluntary agencies against the pollution of the river Tungabhadra by a Birla company, Harihar Polyfibres.
- Sanjeev Ghotge and Ravi Chopra travelled together to do a special report on the environmental and human effects of mining.
- Bhubanesh Bhatt feigned illness to get himself admitted to a hospital to talk to people who had been shot in the police firing in the Bharatpur sanctuary and then travelled extensively in Madhya Pradesh to assess the impact of the urban fuelwood demand on the deforestation of the state.
- Naren Panjwani, having heard nice things about the slum upgrading schemes in Hyderabad, decided to go and see things for himself.
- Darryl D'Monte left home to come to Delhi and plod through piles of material and talk to people with divergent opinions to put together a report on the state of occupational diseases in India.
- Kalpana Sharma delayed joining the Indian Express for two months to help us in editing the report and in the process gave us the real push to pick up speed in our work.
- Dileep Chinchalkar left Indore for months to design the book and express ideas in pictures where words failed.

These are just a few people that we have mentioned. There are dozens of others who have readily supplied us with information, have drawn cartoons and sketches and have written articles and draft papers based on their vast experience and travel. Praful Bidwai spent months, for instance, writing his report on the environmental impact of nuclear power. While most of the people who helped us were individuals and members of voluntary agencies, there were many also from the government and international agencies. Some of these may not even like to be named but indeed our gratitude to them is immense. They helped us to cross-check information, to confirm or repudiate opinions and rumours and get us documents like the proposed Forest Policy, which have been off limits to non-government people.

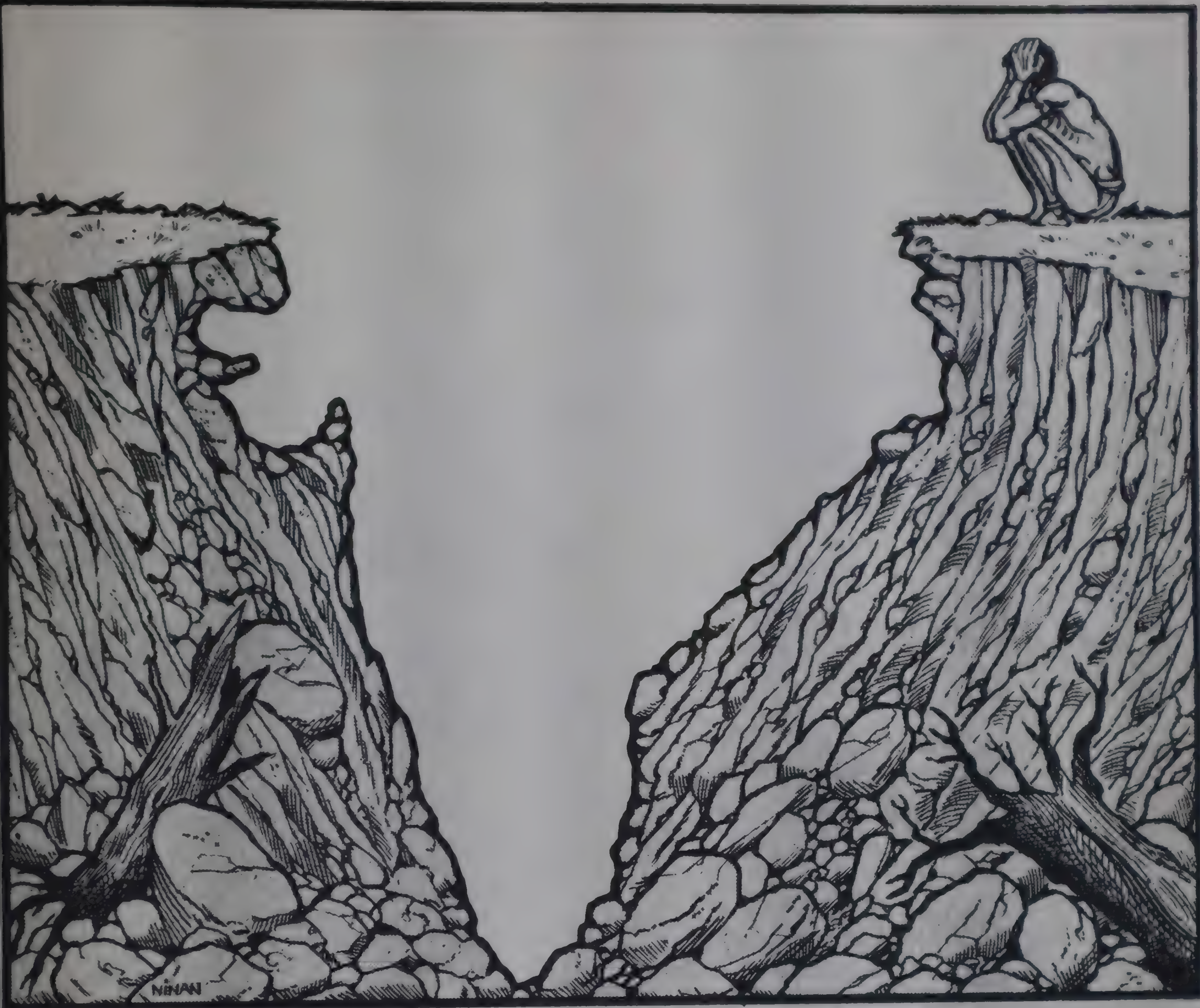
Indeed, the first report gained us such enormous credibility that in many cases government agencies and officials sent us information of new programmes themselves or in response to a simple letter from us. At least most our letters now get a reply, sometimes even angry and hurt replies, especially from foresters, but that we get a reply can be considered a major response from the government to the report. The flow of information has definitely been enormous and without this flow it would have been impossible to piece together information on India's vast and changing environment.

We have failed miserably in one thing, that is in making fuller use of the network that the report has helped to build up. Hundreds of letters have come pouring in to us and equally dozens of people from across the country have come to meet us. If we add the network built up by other editions in Indian languages, we have thousands of extremely interested and active people, an extraordinary base on which to build a network for joint activities. We do hope that after this report is out, we will be able to work more closely with all these friends and colleagues to push environmental concerns and action.

We must point out to several shortcomings in the report. Despite the fact that we have published two reports by now we have still not been able to publish a detailed report on the environmental impact of the green revolution, on the degradation of marine ecosystems, on the future of our water resources if current trends continue, and so on. This report does not contain any section on the rural habitat. Towards mid-1984 we felt that a good theme for this section could emerge from an identification of these factors that are leading to migration from the rural ecosystems. But then in the short time available it was not possible to collate the existing information. This report also has several questions, to which we have not been able to provide even tentative answers. For instance, we point out to problems caused by hydroelectric dams, superthermal powerstations and nuclear power stations. What then is the best technology, or mix of technologies, to generate electricity? Is there an acceptable level of environmental and social damage? Or are there social and political contexts in which we can have the technologies and the environment too? We can only hope that future editions will begin to answer such questions and provide information on lesser known but important areas.

At the end of this long journey, we can do nothing but thank all those people who made it so pleasant, exciting and educational, and above all who made us feel that it was all so worthwhile. The number of people who have given us this sense is so large that we cannot even think of listing all of them but definitely every single word from a reader or from a buyer or from a collaborator is etched in our minds. We have tried our best to learn from them and to share the knowledge they gave us. But no one else is responsible for any of the shortcomings in this report except the two of us. We can only end with the hope that this effort will definitely continue, and we do hope our readers will continue to send us information on environmental problems in their areas and their comments and criticisms of these reports.

ANIL AGARWAL
SUNITA NARAIN



# COMMENTS

## THE STATE OF INDIA'S ENVIRONMENT — 1982

The report is unique in more ways than one. For a start, it is the first time that a non-governmental agency has attempted the mammoth task of studying all aspects of India's environment . . . . while the report is a milestone for India's environmental planning and should do much for developing the required consciousness among the people, it is not flawless. It has perforce to rely on government statistics. But, ironically, of the massive degradation of the environment, even these are unable to mask the wounds and the report is still able to bring home the true impact of the tremendous damage done so far.

The report tends to take a "cursory glance" at India's wildlife and nomadic tribals. The lack of time for compiling the report shows up in many places. While the names of ecological movements are sprinkled throughout the report, it would have been better if these were compiled into a single chapter as a ready reckoner for the uninitiated.

— *Raj Chengappa and Paran Balakrishnan, "The Ravages of Man", India Today, New Delhi*

The publication of the State of India's Environment, 1982 . . . . is . . . . a very welcome event, and constitutes something of a landmark . . . . And yet it is necessary to temper the praise with some constructive criticism. At one level, the utility of the report would have been considerably enhanced if the section on 'Resources' at the end had been much fuller. Much of the information included in the report is not easy to come by, often being privately published. Addresses from which documents and other source materials can be obtained would have been most welcome so as to facilitate easier access to information.

More fundamentally, the report manifests a certain lack of conceptualisation in its treatment of environmental problems. This, perhaps, is not so much - criticism of the report as of the present level of environmental awareness in the country. While each chapter vividly describes the extent of environmental degradation and the impact this is having on the lives of people, the reader is left with no clear sense of the direction in which solutions are to be found . . . . Perhaps such an emphasis will be gradually introduced in future editions, making the report even better than it already is. Unquestionably, it deserves to be read as widely as possible. In particular, its use as prescribed reading in senior schools and junior colleges . . . .could go a long way in ushering in a new phase in environmental awareness in this country.

— *Rusi Engineer, "Getting it all together", Business India, Bombay*

A citizens' organisation . . . .has recently published a study which presents a comprehensive and detailed picture of the current state of India's environment . . . .

It has become necessary to stop the further deterioration and destruction of the environment not just to maintain the quality of life but for the very existence of life. This should now be accepted. It should also be accepted that there is no real conflict between development and environmental conservation . . . .The cotton wool must be taken out of the ears of state governments and they must be given the message of environmental conservation. And it is also clear that this sensitive question which touches the life of the entire society cannot be left only in the hands of governments. The society as a whole will have to play a major role in finding a solution to this problem . . . .

— *Editorial, "The Demands of the Environment", Nai Duniya, Indore*

. . . this document is, among other things, a powerful plea to reorientate our national policies to subserve in real terms the common good of the majority of people, and to allocate resources not on the basis of traditional financial criteria, where people do not come into the picture at all. Conservation implies taking a total view of things and when we fail to do so we end in disaster.

— *Zafar Futehally, "Socio-economic link with Conservation", Indian Express, New Delhi.*

A few months after I had quit a newspaper job last year, an acquaintance met me and asked what I was doing. I told her that I was working on a book on three environment cases. "Oh, I see" she said. "So you've turned your attention from people to things." The remark stung me, though I didn't show it . . . .But here, as well as in the West, environmental objections are immediately seen as being "anti-development" and "unscientific". The debate isn't all that easily resolved, especially in countries like India which can ill afford to do without oil, fertiliser and power . . . .

. . . environment does have to do with people. There is an extreme view, which I prefer to distinguish by the tag "conservationism", which calls for the preservation of all things natural without any thought to the people who may be denied a better lifestyle as a consequence . . . . . If one accepts that environment has to be inextricably bound with development, much of this extremism vanishes.

A group of Journalists . . . . have brought out a "State of Environment" report for India in 1982 . . . . I can hardly do better than quote the "statement of shared concern" which we, the contributors, signed . . . . "Environmental degradation and social injustice are two sides of the same coin. The human condition and the state of the environment are closely related to each other."

— *Darryl D'Monte, "A statement of shared concern", The Economic Scene, Bombay.*

Unlike most writing on exhaustible resources and the environment, this report is not about the future, the 21st century or a doomsday. It is, as the title says, a commentary on the current state of India's environment in the context of the basic problem of poverty . . . . .

Consideration of environmental issues in development . . . . highlights two sets of conflicts. On the one hand, there is the conflict between different social groups and on the other hand between growth and consumption in the short-term and sustainability in the long-term.

These considerations are often trivialised even by perceptive social scientists. That they are not at all marginal but indeed of a frightening dimension has been forcefully brought out in the report . . . .

The other theme that emerges from the Report is that given the technology currently in use, continued emphasis on growth will, through environmental degradation, very soon lead to severe constraints on further increases in production. Agriculture is the sector likely to be most seriously affected . . . .

By highlighting the dimensions and rate of environmental degradation the Citizen's Report has performed a valuable service. In the coming years, it will be necessary to explore ways of providing a higher quality of life to those outside the mainstream of current development activities while preserving at the same time balance of the physical environment. It is hoped that the specific questions thus arising will be dealt with in detail so that the annual assessment contributes to a continuing debate.

— *K.P. Kannan and Ashoka Mody, "Environment and Development in India", Economic and Political Weekly, Bombay.*

We have problems with the information given on the Chipko movements in this report dedicated to the women of Chamoli. It has been reported that Chipko was born in March 1973. We do not believe that people's movements are born on a particular day like a person. Nor is it true that this movement was born because of the Allahabad sports goods manufacturer. There are certain basic factors that create the environment in which a people's movement can be born and there are certain immediate causes that bring it to the fore. There has been no mention of the movements that took place in Uttarkashi, Chanchridhar, Dhyari and Janoti-Paldi. Towards the end, the movement has been called a women's movement. Despite the extremely important role played by women in Reni and Bhyundar, this movement cannot be described a women's movement just as much the participation of students, Sarvodaya workers and communists does not make it a student, Sarvodaya or communist movement. In fact, the main thing that constitutes the success and greatness of this movement is that all sections of society have participated in it. The report has also not reflected adequately the work done by workers in Chamoli over a long period of 10 to 12 years, the extraordinary role played by Chandi Prasad Bhatt and the support he got from all around. It is natural that we do not expect such shortcomings in the next report.

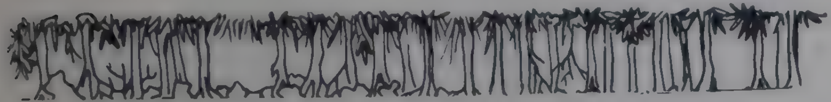
In the end, one more thing. Such an eye-opening publication has been prepared for the first time in the country. Because some people consider English to be the language of our environment, the English edition of this report has indeed come out in 1982 but the editions in Indian languages have not yet been published. Should the truths revealed in this book be first told to the people of this environment or elsewhere? This question is natural . . .

— *Shekar Pathak, Pahad, Nainital*

Influenced by the environmental planning study of the Shahdol Group, the CSE report defines the ecological problems as a struggle over resources, but this is not going far enough. It is not merely a struggle of two groups fighting for the same resources, but that one group needs for its perpetuation or survival practically all the resources used by every other group, culture or species. For this reason, ecological issues are indistinguishable from lifestyles, rather, the clash of lifestyles which results inevitably today in bamboo craftsmen being sacrificed at the altar of paper mills, if one wants a good example. Profits require the elimination of traditional lifestyles and resource use.

This major confrontation the report often describes but never capably analyses and this is its major deficiency. Perhaps the criticism is misplaced, if the original intent was merely to present a dramatic picture of environmental desolation. But in what manner can such erosion be reversed? That is the most difficult question of all, for the solutions lie in not merely planting more trees, but in a willingness to act against the rich, not the poor, against the modern consumption pattern, not traditional technology and resource uses, in short, against economic development as usually defined in our times.

— *Claude Alvares, "CSE's Outstanding Documents: Ecology as if people mattered",*
*Deccan Herald, Bangalore.*



It is towards creating greater public awareness of the problems of environmental degradation, especially under our conditions, that the report could be a great boon. It is written in a style anyone would understand. But the price of the hardcover edition may keep it away from the average reader. One hopes low-priced paperback editions will be brought out so that it can reach the masses. After all, it is they who need to know more about their own environment if they have to act.

— *Biman Basu, Science Reporter, New Delhi.*

. . . the cover is disturbing for it carries a picture of human figures joining hands and dancing round the biosphere, as though it were some kind of children's game. I'm not suggesting that the second edition should be emblazoned with a death's head, but there did seem to be excessive optimism in the drawing.

— *Stephen Alter, "Wasteland Or Wilderness," India 2000, New Delhi.*

The chapter on Land successfully highlights the first major weakness of the report, in its inordinate reliance on government statistics which it takes at face value (a fact that the authors of the report also note). It would have been more useful if the weaknesses of these statistics were discussed, along with feasible methods of making them more reliable, eg, the use of LANDSAT imagery. There are other problems as well. In the stand taken on B.B. Vohra's suggestion that 40 million hectares be converted to forest, Shekhar Singh is quoted as a critic, but the argument is incomplete since it excludes the employment that may be generated by planting and looking after trees and the additional employment generated by downstream processing. The point is simple. What is needed is not debate per se, as suggested, but a political decision based on economic analysis and firm facts.

In the chapter on Water the non-implementation of legislation and the failure of pollution boards has only been discussed in passing. A detailed discussion of how this state of affairs came to be would have been useful. It would be important to know whether the system can be made to work if improvements are made, or, whether it needs to be replaced. And if so, with what, and by what process . . . . .

We may point out some errors in the chapter on Wildlife. For example, India has 1,200 species of birds divided into 2,061 sub-species, not 900 sub-species as stated. The report seems confused on the time in which an owl can eat 800 rats. Also, the CSE is alarmed that there may be only 195 lion-tailed macaques left in India. We are happy to reassure the CSE and raise the number to 670, at the minimum. Unfortunately, this chapter is mainly historical and does not tell us enough about the current situation. Also, contrary to the report, the forest departments have largely moved beyond the stereotypes of the hunting preserves approach to management practices that are ecosystem oriented. Perhaps the chapter reflects the appalling state of wildlife research in the country . . . . .

To move to a more general level, several issues arise.

First, there are important aspects of the environment that find no place in the report (some of which have been acknowledged) . . . . Second, the style of writing chosen is one that avoids references. From the short list given at the end, it is not possible to associate the views in the chapters with people whose works are referred to . . . . Thirdly, a major lacuna is the absence of a list of concerned citizens and groups in different parts of the country. If we wished to protest the lack of safety factors in some Bangalore factories, who would we go to? What could we do?

The report must either decide to expose various positions on the environment and development spectrum, or it must take a definite stand on these issues. An emotional style of writing may not be useful in advancing, in the long run, the cause of environmental conservation. Rigorous analysis is the need of the hour.

This raises the issue of citizen's report. Asfull members of the network, we ask, who are the citizens? How do they come together? How do they sustain themselves in terms of their common (and differing) concerns? How representative is this citizens' group of this country? Is this question important? What are the interests of citizens in such a group? Should they not be openly declared? How does such a group continue its work? How does such a group of citizens get access to information, especially official documents, without statutory support, such as the US Freedom of Information Act? Is this not a right that must be fought for, particularly in the field of environmental conservation?

It is because we hope that the CSE Report on environment will be an annual event that we have raised these awkward issues. It is the success of this report that has made possible a deeper appreciation of the complex issues involved.

— *Vinod Vyasulu & Rauf Ali, "Environment and Development in India," Economic and Political Weekly, Bombay.*

As we live in Himachal Pradesh, one of the environmental problems of which we are most aware is the deterioration of the forests here. Much timber is felled for making apple crates--a real waste!

In response to your request to know from your readers what could be added in future reports: it would be valuable to have a volume filled with practical suggestions (such as the technology for these crates!) so that a concerned reader, from the individual to the business level, could get information and inspiration as to how he could contribute to the well-being of the ecology of his area.

— *Letter from Celia Frey, Dalhousie (Himachal Pradesh)*

As I have very moderate financial resources, I cannot afford to purchase costly books as 'State of India's Environment', I have passed the brochure of that book to a leading scientific books seller of Jodhpur . . . .

— *Letter from Inder Kumar Sharma, Jodhpur (Rajasthan)*

I think it is an extremely valuable document and I am sure the next one is going to be better . . . .

If you call it a Citizens' Report, maybe the unknown citizen should be quoted more often, that is, people from the field, in villages, towns and slums, ordinary citizens. Authorities and experts we can do without or minimised to the barest minimum. A Citizens' Report to my mind should be a Report from us to the planners/policy makers/so-called experts, so that they read, listen and learn (hopefully), not the other way round. As it is, for a Citizen's Report, it is far too technical. It should be simple, understandable and based entirely on field experience. There are many examples quoted from the field but not enough.

More effort should be made to show how rural communities (the poorer part) are already self sufficient and how they depend on the non-institutional human resources in a village rather than government delivery systems.

One whole chapter is needed on the terrible after-effects of electricity on the economy of the poor. Quite apart from being an environmental hazard, the socio-economic impact of bringing electricity to a village is worth studying, especially how it generates unemployment.

Maybe some more detailed information should be added on the relevant acts passed by Parliament (water pollution acts, land ceiling acts, cattle acts, migrant acts etc), where are they being enforced, cases pending, convictions, which States are observing them at the village level, etc. This would be enough of a commentary in itself.

— *Letter from Bunker Roy, Tilonia (Rajasthan)*

This report has been of invaluable assistance in a project which I have persuaded one of our clients to undertake. This is a public service advertising campaign to draw urgent attention to the degradation of the environment. It is a series of five advertisements and the campaign has been created entirely on the basis of the information provided in your report. I thought I must tell you that campaign has no commercial objective whatsoever.

— *Letter from Nirmal Goswami, Bombay (Maharashtra)*

I . . . like the stand it takes in favour of the people. But it does appear to me that the connection between population numbers and environmental degradation has not been given due prominence, nor, apparently, is it appreciated that a definite relationship exists and must be maintained between cultivated areas and the uncultivated areas of forest, pasture, etc — what I call 'the support areas'. All the evidence of the evils of our population are given, but the conclusions are not drawn. The need to rehabilitate the uncultivated lands is seen, and some of their contributions to human subsistence are mentioned, but it appears not to be seen that the carrying capacity of the country — i.e. the maximum sustainable population — is related as much to the productivity of the support area as it is to that of the cultivated area, and that in many instances, the productivity of the cultivated areas depends upon the productivity of the support areas.

I mention these points because they are fundamental to the formulation of clear policies in respect of the environment, and to clear and equitable decisions in regard to priorities in land use. Things like pollution, dam building policy, industrial employment hazards are not necessarily related to population density or to standards of living — mercury pollution in a river should not be measured by the number of people affected or whether they are rich or poor. But to give paper pulp forests priority over fuel forests is madness, when shortage of fuelwood means burning dung, less manure for the fields, less food, more food imports, less development funds and less to spent on raising standards of living above mere subsistence.

— *Letter from Madhava Ashish, Mirtola (U.P.)*

. . . taking liberal advantage of your copyright terms, we are relying heavily on statistics and excerpts from the report to prepare some of our exhibition material . . . .

— *Letter from Ravi Bhagwat, Pune (Maharashtra)*

I have been reading and re-reading the report—at least parts of it to be sure—and talking about it to my colleagues. At least one student of mine feels encouraged to prepare a report for this city, along identical lines.

— *Letter from Dr S.B. Chaphekar, Bombay (Maharashtra)*

With sincere congratulations for 'The State of India's Environment' . . . I like to request you that we have done the preliminary work for its translation, awaiting your kind permission. The brief information of the book has been circulated to one thousand people . . . .

— *Letter from A. Mishra, Burla (Orissa)*

This report is not devoid of mistakes. The report gives a romanticised view of the prevailing conditions. The unfortunate aspect is that they seem to give the impression that they are not for modernisation and industrialisation and they have failed to mention the remedies for solving these problems.

— *Comments of Sally Thomas, Cochin (Kerala), who was asked to read the book for her law course.*

How does it happen that Lathyrism was left out? In our area this year, the markets were full of "teora", or "khesari" as it is elsewhere known. In fact, there have been reports for several years that the crop is now grown under irrigation as a cash crop (presumably for adulteration of "besan"), the major sales going to Andhra Pradesh from here.

Within the areas touched, some important controversies have not been highlighted. For example, there are strong arguments for cheap, standard milk powder and weaning foods for young children being made available for working mothers. This should not, of course, replace breast feeding, which may be total up to six months and partial thereafter. The problems are of poor hygiene (therefore, the need to discourage bottle feeding) and overdilution. These are problems which will persist with poverty (maintained by the very existence of a privileged class) and must be attacked closer to the roots. Among "working mothers", I would like to include every woman who works at home, not only women who work outside the home.

The all-permeating effect of the system of private practice of medicine in sabotaging all people-oriented medical services has not been pointed out in the report. It is in fact the infrastructure providing day-to-day insurance for the capitalistic pharmaceutical industry. Of course, you have mentioned the stranglehold of the multinationals, but it is not generally realised by most citizens that this stranglehold is within the system (which benefits from illness), not just from outside, and most of us are forced or enticed, in one way or another, to participate in the strengthening of the stranglehold. How exactly people support the stranglehold of private practice helplessly or unknowingly is a good area for investigation, and must be highlighted in future citizen's reports on the state of health.

No representatives of any people's organisation (the organised poor or working class) has been quoted in this Citizen's Report.

As a first attempt, this report has some value, in that it collects a lot of problems together in the same place for many readers . . . . The major question which we will want answered is who and how many are these readers, and will it have any measurable effect? How does one find this out?

The Chapter (on health) is still really a collection of problems which has not been given any sort of analytical framework which might hint at why we are saddled by such terrible realities, which might help us see undeniable overall links, and urge us to look towards a particular direction of thought and action in future. Will future "Citizens' Reports" take up this task?

— *Letter from Mira Sadgopal, Hoshangabad (Madhya Pradesh)*

I was overawed by the magnitude of the problem and angry at our society (including myself) for our complacency. I must, however, add that environment protection is more of a fashionable jargon than any concern for the environment. Even among the educated people in our country, how many would know of the severity of the problem as highlighted by you? I think it would not be out of place to introduce this book as part of the curriculum in every graduate course and develop books for teaching senior and primary school children. We can't hope to protect the environment without mass concern, as illustrated by the Kerala example. I came across the book quite accidentally and would like to procure a copy for myself . . . .

— *Letter from N. Ashok Kumar, Pune (Maharashtra)*

Today in the 'Asiatic Society Library' I saw 'The State of India's Environment 1982-A citizens report' published by you . . . . One more pleasant surprise came when I read that the book is being translated into regional languages like Malayalam and Marathi. I was specially happy because Marathi is my mother tongue.

I am a free-lance journalist and continuously make efforts to bring various scientific information to Marathi readers. If I could be helpful to 'Parisar', the organization which is translating the report in Marathi, even to a small extent, it will be my greatest pleasure ....

— *Letter from Vinayak Joshi, Bombay (Maharashtra)*

This book is not only overpacked with facts, but it relates the knowledge of environment very seriously to the economic and cultural conditions of the masses of India. I dislike the scheme of alloting the least number of pages to chapter seven (on people). But that is compensated by the fact that every other chapter does have a people content. The statement at the end, although it falls short of a programme, does credit to the authors in that it spells out their positive inclination for a social commitment.

After reading a few chapters certain things around me became more visible; for example, two days ago when I boarded a passenger train at Titilagarh and saw a hundred women getting down at the next stop which was a semi-forest area, I asked my co-passengers if these women were going for crop-cutting (it is harvest season). The answer was "no, they will return in the evening with headloads of firewood". So there are so many "firewood specials" whose TTIs collect 25 paise from each woman.

Sometime back I had discovered that the higher secondary syllabus does not any more have 'history' and 'geography' papers. Instead they have 'social studies' and the prescribed books are so nondescript and purposeless. I hope a book like yours could be made a text book. I detest the subject environmental Science as a department of higher education. I shall like it at the higher secondary level, where it will serve a national purpose.

— *Letter from Kishen Pattnayak, Bargarh (Orissa)*

... I have not come across any environmental stocktake for anywhere in the world which approaches the completeness of this report. The report is not just large; it is also important. It will strengthen the hand of many small groups opposing state and capital in their different manifestations throughout India, and will help those groups to build a sense of their larger identity and collective strength. But the report needs to be situated: its concerns and weaknesses reflect common features of environmentalism.

The authors' position on development can be identified by the key words 'Gandhi', 'alternative technology', and 'populism'. Although the report hardly mentions Gandhi, it is suffused with an implicit advocacy of small scale labour-intensive, rural technology, which in India is associated with the heritage of Gandhian ideas ....

This 'neo-populist' advocacy of the small stems in part from one important strand in the environmental movement - a general concern that small-scale producers should not be smashed by development .... This championing of the marginalised small-scale producer meshes with the more superficial concern to conserve nature (and with struggles around gender divisions) in India's best-known and most important environmental movement, the nonviolent Chipko (or tree-hugging) movement against commercial deforestation in the Himalayas ....

... It is crucial that small producers, who face dissolution (or at least partial separation from their means of production) throughout much of the Third World, should have their interests represented. But concern for the fate of the small-scale producers needs to be distinguished from an uncritical support of small-scale, 'traditional' technologies (and relations of production) as a way forward. It is by no means certain that maintenance of 'traditional' relations with nature and with wider society will best serve their interests ....

... Even without state support, the mechanised trawlers are almost bound to prevail over the dugouts and catamarans .... A socialist India might both mechanise fishing and improve the diets of the poor. It has yet to be shown that prolongation of existing or even 'intermediate' methods of production within a capitalist economy is a generally effective strategy for meeting basic needs (though it may be a useful political demand) ....

... Environmental movements develop and gain legitimacy through periodic 'Panics' primarily about physical constraints on society—panics frequently associated with cycles of capitalist development—and through the long-term development of ideas about, and actual relations to, 'nature'. The Indian environmental movement, as represented in this report, shares such ideological dynamics. Thus the spectres of desertification, climatic change and irreversible pollution can be discerned (waiting to reap their wrathful harvest at about the turn of the century), and their report is simultaneously conservationist and utilitarian in its attitude to nature.

'Panics' can, however, be orchestrated by both right and left .... At the conclusion of the report, they attempt to ... justify a more general concern with nature as a basic goal or meaning of development.

If they will forgive the natural metaphor, that way may lead to wild flowers but I fear the surrounding swamp. For example, 'A Statement of Shared Concern' at the back of the report contains these sentences: "Environmental degradation invariably results in increased economic inequalities in which the poor suffer the most. Environmental degradation and social injustice are two sides of the same coin."

Were this assertion true it would be a profound insight into the human condition. Yet there is no such direct and simple link between changes in society and changes in nature. Industrialisation, under both capitalism and socialism, has led to environmental change. It has also frequently increased inequality. But industrialisation, at least in the most industrialised countries, has resulted in the bulk of the people becoming absolutely better off (which I take to be the minimum content of any definition of development); it has also brought the potential for decreased inequality at higher living standards. In the long term, therefore, 'environmental degradation and social injustice' are most definitely not 'two sides of the same coin'.

... The concept of 'nature', a powerful part of many ideologies, needs to be handled at least as carefully as any endangered orchid or panda. Sadly, environmentalists do not do so. Crude 'environmental concern' rests ultimately upon a static view of nature. It entails a paradoxical tension: between the need on occasion to emphasise anthropomorphic characteristics of animals and plants, and at other times the need to maintain a strict segregation between nature (=good) and humans (=bad). This ahistorical view of nature–a Garden of Eden defiled by humanity–is signalled by the use of words like degradation (more usually destruction). Is any change, we may ask, a degradation? Are improvements or transformations never made?

I am surprised at the extent to which this report rests upon such crude environmentalist axioms. An Indian environmentalist movement would be well-placed to answer two questions which could lead us toward a more sophisticated understanding of nature. The first is: in what ways has the relatively recent development of more compassionate ideas about nature actually hampered the economic development of a 'late-developer' like India? And the second: how do the 'animist' beliefs of some of the adivasi small producers interpret changes which are currently taking place? Do they invariably see nature as static and good?

... Perhaps in future years The State of India's Environment can be made even more useful by introducing an understanding of what is happening within the peasantry, an analysis of social change.

. . . the environment, in India as elsewhere, is being changed in accordance with the requirements of particular forms of economic development being pursued and the nature of the class struggle being waged. The authors of The State of India's Environment want neo-populist development–small-scale, decentralised rural development based on development of artisanal, aboriginal and peasant traditions, possibly eschewing industrialisation . . . . But the authors do not want to prolong 'traditional' poverty nor do they support the poverty induced by the development which is taking place. The questions then arise: which environmental changes are necessary to abolish poverty? Will environmentalists oppose those changes?

— *Ben Crow, "Lost in Forests of Aboriginal Goodness?", Radical Science Journal, London.*

The report itself is a remarkable achievement. Researched on a shoestring largely from information from voluntary groups, it is an attempt to put together all the different aspects of a country's environment, stand back, and see how the picture looks. Predictably perhaps, its findings are depressing.

— *"India's changing landscape", The Economist, London.*

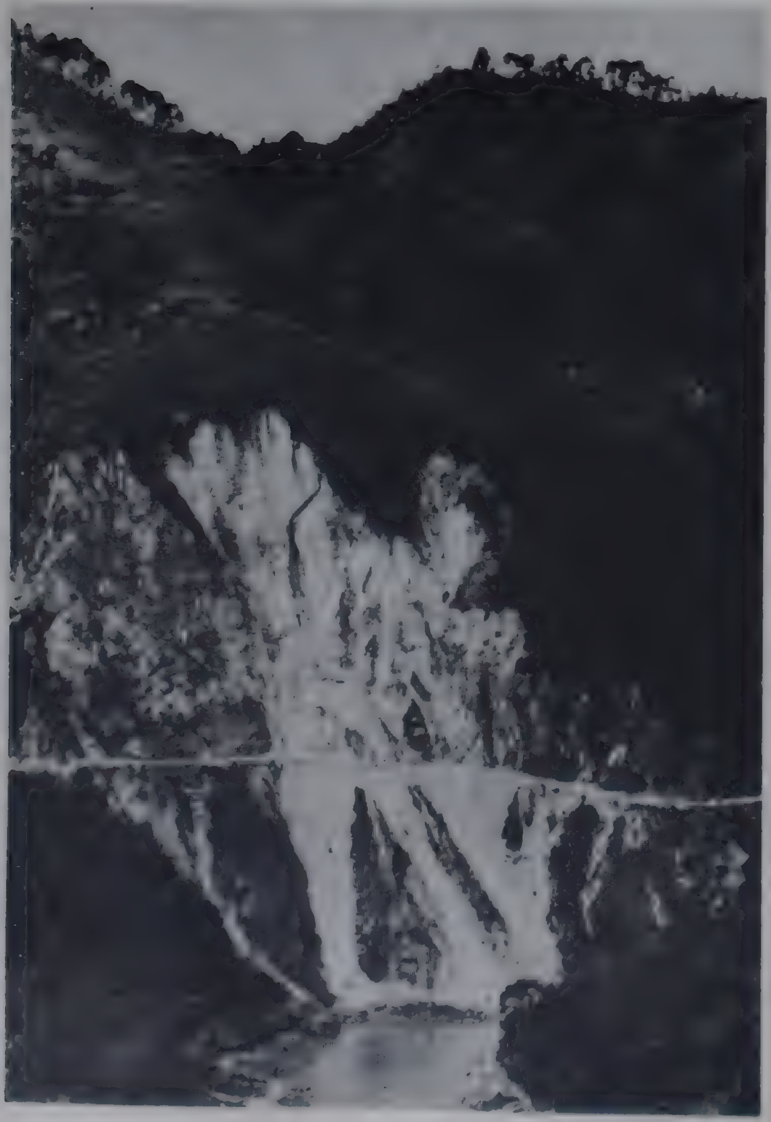
The original idea came from another leading Third World "non-governmental organisation": the Malaysian Friends of the Earth and their much shorter annual pamphlets entitled "State of the Malaysian Environment".

Both reports offer models for non-governmental pressure groups in other Third World nations whose environments are being "overdrawn" to speed economic development.

— *Lloyd Timberlake, Earthscan feature, London.*

. . . .their Statement of Shared Concern . . . . begins to question a little further, although not yet completely, the very notion of development

— *"A Statement of Shared Concern", Interculture, Montreal*



The authors of this report (which would deserve a translation into French) have brilliantly proven that good research is not at all a monopoly for academic or official institutions. Non-governmental organisations have also an important role to play in research

— *Ignacy Sachs, "Une critique de la strategie de developpment", Le Monde, Paris*

In a report such as this, especially one prepared in such a hurry, it is always possible to pick holes and point to minor inconsistencies. I prefer to regard it as a hypothesis, which will be tested in the light of fresh or improved evidence over the years (the authors have promised an annual update). At this stage, we have for the first time a benchmark against which progress can be tested.

— *Mark Halle, " 'Citizens Report' on India's Environment", WWF News, Gland (Switzerland)*

Western readers will be surprised to find almost no comment (except for the statement that urban numbers have doubled in the last 20 years) on the subject of population . . . The chapter on "People" where such information might be expected deals with the plight of fisherfolk and nomadic tribes. The authors apparently do not agree that most of the damage to the environment is connected with the vast increase in the number of Indians.

The solution proposed . . . is to build up self-reliance at the community level, and to develop a civilisation following the ascetic ideals of Mahatma Gandhi . . . there is a risk that some of these idealistic proposals will encourage old customs and an even higher birth rate. This could, in my opinion, have ramifications which could make the environmental degradation here reported look almost insignificant.

— *Kenneth Mellanby, "Darkness in Asia", Nature, London*

I would like to see a budget presented in real terms in a real sense. A budget in real terms would be a resources budget. Oil would be counted for what it is, not merely in its money value . . . .

. . . The State of India's Environment 1982 . . . is a model of what could he undertaken in this country. Even if this is not likely to get official blessing, it is not beyond the capacity of the unofficial environmental movement to take on. Ideally, there needs to be some coordinating institute of resources studies whose main function would be the production of a report, on the state of Britain's environment, possibly biennial if not annual . . . . This could be an approach to a resources budget. At some stage in the near future this must come to be seen as a sensible and necessary aid to rational political decision making.

Currently, though, it must be said that politicians have been slow to understand the environmentalists' case . . .

— *Harford Thomas, "Howe should budget for resources and not just for monetary objectives," The Guardian, London.*

The book makes for grim reading. It is important to remember that it is pointing out the costs of development — not the benefits. The centre should have a large amount of information from which it has distilled these chapters. They might consider putting out additional monographs dealing with specific aspects of the environment. A section with important statistics may also be attached to the back or put out separately on a regular basis. That would prove to be an important resource for all who would attempt to improve the environment.

— *Ashok Bhargava, Association of Indian Economics Studies Newsletter, U.S.A.*

I was particularly touched by the statement at the end of the volume. I am sure that this beautifully poignant plea will be quoted very widely . . . Especially relevant is the relationship you point out between biological diversity and cultural diversity. Nowhere else have I seen this issue so clearly and concisely put.

— *Letter from Michael Soule, Los Angeles (USA)*

If one reads the normal literature on development economics all the problems so vividly described in your report are conspicuous by their absence.

— *Letter from Dietmar Rothermund, Heidelberg (West Germany)*

# DESH KA PARYAVARAN

Nature, human beings and culture constitute an amazing and abiding triangle . . . through a persistent manipulation and sculpting of natures, human being create their social milieu . . . . The recently published book Desh ka Paryavaran challenges the ideology that nature is nothing more than a raw material for production . . . .

Desh ka Paryavaran has also some limitations and shortcomings. The report has not been able to touch several issues of the problem, some of which have been indicted by the authors themselves . . . . The authors are, however, very right when they say that "this report can be recommended for use in schools and colleges as a part of the curriculum."

— *Kishore Vyas, "The environmental bank is being depleted", Nai Duniya, Indore.*

Te environment of poor india is getting poorer rapidly. Except for a single Chipko movement and its recent spred to Karnataka there does not seem to be any great concern about environment . . . . In such a situation, this amazing report published recently by the name of Desh ka Paryavaran does not come to us just as a piece of bad news, rather it seeps into our consciousness and warns us.

There was no non-governmental report until now which could give us a true and responsible picture of the country's environment. There was a need for a book that could play the role of a citizens' report in face of government documents. In any government report, the bureaucrats' fascination for collecting statistics overshadows any concern for people whereas people have to be at the centre of any citizens' report . . .

Several aspects of the environment have been left out in the report which has been acknowledged in the Introduction. It was necessary that some information be provided on pollution control technology.

— *Madhusudan Anand, "An amazing document of human concern", Navbharat Times, New Delhi*

There is an urgent need to acquaint every student and citizen in every village, small town and city, situated whether in the forests, rural areas, deserts or the hills, with the dangers to the environment and of useful ways to prevent them. This report is a good and concrete step towards that end . . . It is priced at Rs 100 which definitely looks high for an ordinary reader. But every good library and educational institution can provide it to its readers and students. I make a strong recommendation for this book to be read by everyone and for everyone to get others to read it.

— *Raghuraj Gupta, "Acquaint yourself with the Environment", Amrit Prabhat, Lucknow (U.P.)*

. . . What will be the structure of the economic plan, socio-political relations and institutions that will bring about environmental protection and an egalitarian society? This question has been discussed in the book at different places essentially in the form of criticism of the existing development process and in the form of a few useful principles. The statement of shared concern published at the end of the book also does not go beyond a few major points. The important question is what is that technology which will bring about an harmony between such major goals as environmental protection and social equity. Until this question is answered the environmental movement will not be able to go beyond criticism of the existing development process or a few attempts to reform it here and there. The next report should pay greater attention to this question and an attempt should be made to define clearly the new dimensions of development. If possible, this can be presented as a companion volume to this report.

— *Ganesh Mantri, "A Deteriorating Environment: Increasing Social Injustice", Dharmyug, Bombay*

I am not only satisfied but also happy with what you have written about the price of Desh ka Paryavaran. It is extremely important to take a practical, if not commercial, approach like the one you have adopted to get the book to the right people. My suggestion is that the earnings from this report should not be used to support local groups but to produce similar frank and constructive reports related to environmental problems. For instance, it would be really nice if Hindi-speaking workers could get reports on the environmental impact of the Narmada Sagar project or on the project or on the effects of the power stations being built at Singrauli.

There are many agencies from all over the world today ready to support local groups. But there are very few agencies analysing and reporting on the environment in Hindi. There are many possibilities for translations from other languages, especially from English. For instance, the Hyderabad Book Trust has translated and published several excellent articles from the Economic and Political Weekly into Telugu. At one level, Granthali is trying to play this role in Marathi. I would, therefore, recommend that these earnings should be ploughed back to produce other reports in Hindi.

A friend of mine is organising landless and small farmers on land and water issues in the Khanapur taluka of Sangli district. He is also organising a vigyan yatra on these issues in November with the help of the Lok Vigyan Sangthan. If you can send him a copy, it will be very nice.

*—Letter from Arvind Gupta, Pune (Maharashtra)*

It would have been nicer if a cheaper edition of the book had been prepared. This book could have done with less illustrations. The 'boxes' were very informative and could definitely have been retained. But with slightly cheaper paper, this book could have been made more readily available at lower prices.

On balance, this work is nothing more than a 'voice of reason'. Unfortunately, this 'voice of reason' is not getting the support of the 'force of history' in this day and age . . . . Even then it is an important task to keep this voice alive and respectable. At the moment we should satisfy ourselves with only this much.

— *Letter from Kuber Nath Rai, Nalbari (Assam)*

I feel that similar citizens' reports should be published on other subjects also. For instance, there could be reports on the communal situation in India, the state of rural women, especially Harijan and nomadic women, land and water problems, is India a federal state today, the meaning of national integration, etc.

— *Letter from Shantaram Pandere, Aurangabad (Maharashtra)*

Even worse than the deterioration in the natural environment is the deterioration taking place in human concerns, behaviour and relationships. Humans are out to finish humans . . .

To write on the Chilar river, I surveyed every place. I have written an article on this for Nai Duniya. Desh ka Paryavaran was undoubtedly a very useful reference for preparing the article on this river. For this, my thanks.

I, too, have strongly believed that unless people take it upon themselves to improve the environment, the administration can hope to achieve little success by itself. The leadership of non-governmental organisations will be vital to get this going. This time, on Holi, I pleaded with people in various mohallas to burn less wood. But presumably because I was alone, little attention was paid to my pleas. I felt very bad. I cannot understand why public opinion is not being created for this.

— *Letter from Piyush Mathur, Shajapur (Madhya Pradesh)*

# LAND

*With just a fortieth of the world's land, India supports over half of its buffaloes, and over a seventh of its cattle and goats. As more and more grazing lands are brought under the plough, often as a result of government programmes, the remaining move towards overstocking and eco-disaster.*

*As grazing lands degenerate, people keep more goats, which survive better in hostile environment. In Rajasthan, the number of goats was half that of cattle in 1951; by 1983, there were 14 goats to every 10 heads of cattle.*

*As fodder becomes scarce, people and their animals turn to forests. Violent clashes between graziers and foresters follow as corrupt foresters exploit permits for grazing.*

*The worst affected are millions of nomads. Their cattle starves, and they travel ever-increasing distances. Finally they give up their traditional lifestyle to become landless labourers.*

*Scientists recognise that nomads make best use of fragile arid lands. But the government is interested only in settling nomads, invariably on marginal lands which soon collapse under permanent agriculture.*

*Ironically, when the country faces an acute fodder crisis, social forestry programmes intended to meet this and the fuelwood crisis plant mainly non-browsable species like eucalyptus.*

*India's wastelands—areas affected seriously by salinity, alkalinity and wind and water erosion—cover an estimated 100 million hectares, of which about 42 million are still being cultivated.*

*Four million hectares have already been swallowed up by ravines. In the famous Chambal Valley more than 10 per cent of the villages are completely depopulated.*

*While mineral production (in rupees) has increased nearly 50-fold in the last 30 years, several million hectares of good crop and forest lands have been destroyed by mining operations and hundreds of villages depopulated.*

*The worst affected are tribals. More than half the national mining output comes from 40 contiguous districts of central and eastern India, the tribal heartland of the country.*

Of the three major components of our lands—croplands, orest lands and grazing lands—grazing lands have been nost neglected. Large areas of former grazing lands have ome under agriculture leading to an overstocking of the emaining areas. The result is a hungry and malnourished nimal population while experts debate whether the umber of animals in India is not too large. Meanwhile, vergrazing prevents regeneration of forests and ccelerates soil erosion, turning even foresters and nvironmentalists into enemies of the animal populations.

The environmental problems created by the neglect of India's grazing lands clearly shows that the current compartmentalised management of India's lands—croplands by departments of agriculture and irrigation, forests by departments of forests and grazing lands by departments of animal husbandry, none of which talk to each other or care to understand each other's problems—can only lead to further deterioration of India's lands and impoverishment of its rural populace.

India's lands are also being destroyed by indiscriminate mining activities with little ever being done to restore these lands. Displaced agriculturists and tribals undergo an overnight transformation from a relatively self-reliant people at the margins of subsistence to a callously abused and diseased mining community.

The following chapter describes the human and environmental problems created by the neglect of grazing lands, by the spread of ravines, probably the most horrendous form of soil erosion, and by mining. The three sections add up to a sorry state of India's lands.

# GRAZING LANDS

India teems with animals. They come in all shapes and sizes, from the lumbering black buffalo to the ever nervous sheep and there are millions of them. India with just a fortieth of the total land area of the world supports more than half its buffaloes, 15 per cent of its cattle, 15 per cent of its goats and 4 per cent of its sheep. This livestock wealth plays a crucial role in Indian life: it is a major source of fuel and draught power, of nutrition, of raw materials for village industries. Even experts forget that Indian farmers are not just farmers: they practise a highly interdependent and integrated system of agriculture and animal husbandry.

Animal husbandry directly contributes 5 per cent to 6 per cent of India's national income but indirectly it makes much of the rest possible. As a source of manure and draught power, the cattle are worth their weight in gold for the millions of small farms. A number of village industries such as cane crushing and oil extraction would be virtually impossible without animals. There is also that 6 per cent of India's population for which pastoral nomadism is a way of life. And, of course, without the sturdy bullock cart, life in rural India would come to a halt.

But this huge mass of livestock needs fodder and there simply isn't enough of it. Only about 13 million hectares in the country are classified as permanent grazing lands. As these are obviously not enough, and exist in a highly degraded state, the animals scrounge for whatever they can get on millions of hectares of fallow and uncultivated lands and uncultivable wastelands, as well as 36 million hectares of tropical forest lands. In all, almost all accessible vegetation in more than half the total land area of the country is grazed by livestock—which snap up everything except non-palatable weeds.

**Livestock population in India (million)**

| | 1951 | 1961 | 1972 | 1977 |
|---|---|---|---|---|
| Cattle | 155.24 | 175.56 | 178.87 | 180.00 |
| Buffaloes | 43.40 | 51.21 | 57.94 | 61.96 |
| Sheep | 38.96 | 40.22 | 39.99 | 40.91 |
| Goats | 47.00 | 60.8 | 67.52 | 75.62 |

Source: Data from 1951 to 1961 from the National Commission on Agriculture and rest from the Twelfth All-India Livestock Census

Because of the extremely acute shortage of green fodder, the animals principally get crop residues such as rice and wheat straws. In fact, they don't compete with humans for food, for while humans get to eat the high-value cereals, the humbler animals get the low-value leftovers. This shoddy treatment is in sharp contrast to that in other, more developed countries like the United States, where 60 per cent of the cultivated land is devoted to fodder production. In India, the figure is only 5 per cent. In some parts of the country a negligible portion of irrigated lands has been set aside for this purpose. Moreover, of the 58.5 million tonnes of grain produced in 1977–78 only 2 million tonnes went down animal throats.

The estimates of the fodder shortage are shocking. The 1976 reports of the National Commission on Agriculture pointed out that in 1973 the dry fodder shortfall was 11 per cent and the green fodder gap a whopping 38 per cent. In another survey, by the Institute of Social and Economic Change in Bangalore, the dry fodder shortage in 76 per ce of the districts ranged from 50 per cent to 80 per cent and the green fodder shortage from 50 per cent to 80 per cent fact, there is only one district—in Mizoram—that has sufficient dry fodder and a few in Punjab, Haryana, Gujar and Maharashtra which have enough green fodder. Most animals are fed with whatever crop residues are available and then left to try their luck on fallow lands, unused panchayat lands, river banks and roadsides, uncultivable wastelands and forests. Nine out of 10 animals in the country subsist on this kind of potluck and still go hungry

Indian livestock appear to have adapted to the uncerta fodder situation. The animals have low rates of growth an production and can thus survive short periods of underfeeding and semi-starvation. They breed seasonally the time when mother and calf need the most fodder coincides with good grazing periods. Herds and flocks, particularly in drought-prone and desert areas and in the hills, migrate to places where prospects are better. However, the current fodder crisis cannot but aggravate difficulties when it comes to exploiting the full genetic potential of superior animals such as crossbred cows, an a major drag on efforts to develop breeds which offer mo to society.

"Solving the grazing lands problem is the most difficu environmental problem in the country today," says Digvi Sinh, deputy minister for environment. Sinh hails from Saurashtra and reports that few shepherds from his area would migrate over long distances when he was a child; b now the number is much larger and grazing has become major source of tension. Half the cases in the tehsil court he says, relates to disputes over illegal grazing on private cultivated lands.

The effects of haphazard grazing on the environment alarming. Land degradation due to overgrazing leads to desert-like conditions which in turn reduce animal productivity and increase the economic pressure on hum beings who depend on animals for their livelihood. Thus pastoral nomads turn into landless labourers. And yet, of the three major land areas—grazing lands, forest lands a crop lands—grazing lands have and continue to be the m neglected by the government.

One of the main reasons for overgrazing is too many animals and too little grass. There has been a progressive increase in all classes of cattle and buffaloes since 1951 ar in 1977 there were as many as 180 million cattle and 62 million buffaloes, an increase attributed to the demand created by intensive agricultural practices. The number o goats alone increased from 47 million in 1951 to 68 millio 1972, despite the fact that the goat, a hardy creature whic thrives on shrubs, bushes and thorns, has received no special treatment and that 36 per cent of the goat popula is slaughtered every year.

A second factor is that the government has just stood and watched as grazing lands dwindled in area. In Gujara for instance, permanent pastures and grazing lands whic spread over 1.04 million hectares in 1960–61 occupied on 852,000 hectares in 1976–77, while the bovine population had risen slightly; grazing land per animal was reduced f 0.11 hectare to 0.09 hectare over the same period. A larg portion of Gujarat's grazing lands belong to the panchay he powerful have encroached on them. In addition, e have been shifts in the cropping pattern and a change op varieties. The area under fodder crops in Gujarat declined from 8.74 per cent of gross cropped area in -68 to 8.16 per cent in 1972–73.

n many cases, the government itself has launched rammes like irrigation schemes which have turned er grazing lands into croplands, but without any ern for rehabilitation of the graziers. The Rajasthan l, for instance, has brought vast tracts of land under culture and the earlier nomads who used the area for ing have been driven on to the shrinking grazing lands. tral Irrigation Minister Ramnivas Mirdha, who himself from Rajasthan, says callously: "nomadism is an lated form of livelihood."

third factor resulting in the excessive pressure on grazing lands is the absence of organised fodder production and pasture management. The growing human population has meant growing pressure on lands to produce foodgrains and raise cash crops. Forage crops do not find an important place in crop rotation because of small holdings.

## Rajasthan: a case study

Livestock is an important asset of Rajasthan's arid zone next only to agriculture, and in certain pockets of western Rajasthan, where drought is a regular phenomenon, livestock rearing is the main occupation. With more than 40 million heads of livestock, Rajasthan ranks third in India in animal wealth. The state provides more than 10 per cent of the country's milk, 50 per cent of its wool and is one of the principal suppliers of meat, eggs and milk to neighbouring

### tatus of Grazing Lands

ypical grasslands are vegetation formations that are enerally found in temperate climates. In India, they are found ainly in the high Himalayas. The rest of India's grasslands are ainly composed of steppes and savannas. Steppe formations ccupy large areas of sandy and saline soils in western ajasthan, where the climate is semi-arid, average rainfall less an 200 mm a year with a dry season of 10 months to 11 months, nd a large variation in rainfall. The soil is always exposed, ometimes rocky but more often sandy with fixed or mobile unes. Forage is available only during the brief wet season. The rass layer is sparse and consists mainly of annual grass species. Voody plants are extremely few.

In the central and eastern parts of Rajasthan, where the ainfall is about 500 mm per year and the dry season is of six to ight months, dry savanna grazing ecosystems have developed. he light shade cast by the sparse population of trees like *rosopis cineraria* favours the growth of grasses which in the est watered areas can reach a height of 100 cm to 120 cm.

The major difference between steppes and savannas is that hile all the forage in the steppe is provided only during the rief wet season in the savannas forage is largely from grasses hat grow during the wet season but also from the smaller mount of regrowth in the dry season.

In all monsoonal Asia, where savanna regions are found oday, forests would exist if there was no animal or human ressure. In India the existence of savanna ecosystems is mainly direct result of short or long-term degradation of various orest ecosystems, except in marshy or periodically flooded nds where a savanna would naturally develop or in the arid orthwest where steppe formations in the country are natural. ut these areas would be extremely limited in the country if egetation were allowed to reach its natural forest climax. This limax vegetation can now be found only in inaccessible and emote hill terrains.

In many parts of India, pseudo-steppes which represent the ast stage in the degradation of overexploited soils can also be een. Because of the degradation that takes place as a result of xcessive overgrazing, the savannas degrade and begin to take n the appearance of a steppe.

For instance, in the Deccan, where the largest savanna cosystem consists of shrubs, the soil has become bare in atches and on the degraded slopes of hills, this has often roduced pseudo-steppes.

Pseudo-steppes can be found in India in many areas with a ry season of five to seven months and a mean rainfall of 700 m to 1,200 mm a year and sometimes even in areas with a ainfall of 1,500 mm a year. These degraded formations dry out ompletely for several months and are not sufficient to maintain rge herds of cattle and sheep. Fallow areas of non-irrigated ropland or forests are grazed during the dry season.

The richest grazing lands in India are found in areas having nnual rainfall of more than 1,200 mm and a dry season of no longer than four months. At moderate altitude, about 1,000 metres, these are most frequently savannas with trees and tall grasses which shelter large wild herbivores. These ecosystems have also been generated under pressure from human beings. Their extent increases under shifting cultivation and their equilibrium is maintained by annual fires.

The problem of overgrazing is particularly destructive in certain ecoclimatic conditions. Studies by Dr S.C. Pandeya and his colleagues at Saurashtra University show that the effects are the worst in the arid and dry subhumid areas. The dry subhumid tract of western India receives about 1,000 mm annual rain and has a wet period of three months, from July to September. Subsequent months are generally dry. As this tract is near the Tropic of Cancer the amount of solar radiation and potential evapotranspiration is high. Absolute temperatures of 48°C to 50°C are not rare in May. The natural vegetation is dry deciduous forest.

But once it is removed because of tree-felling and heavy grazing, the hilly character of the terrain and the land and the level of rainfall, between 800 mm and 1,000 mm, ensures that the upper mantle of clayey soil is quickly washed out. A high heat flux further scorches the terrain during the eight to nine months of dry period. Consequently desertification sets in. Without large scale plantations of trees on a priority basis, desertification is bound to spread in the central Indian dry subhumid tract.

Under heavy grazing pressure, the quality of grasslands also deteriorates rapidly. In arid to semi-arid tracts, active growth of vegetation is triggered each year by the advent of the monsoon during June or early July. The biomass increases to its peak value around September to October. Fruiting is completed by September and subsequently the plants dry up. In subtropical parts of northern India which receive winter rains, there is usually a second flux of growth in December and January.

The decline in biomass is sharper in more arid to semi-arid localities. In western Rajasthan, there is a flush of annual grass due to rainfall from July to September, but this is used immediately by the grazing stock. Sorghum stalks are then fed and finally the animals have to migrate to the humid zone. In years of drought the situation worsens.

Animals have selective grazing habits due to which the most preferred grass species are always overgrazed first. Such grazing habits damage the most palatable plants first and then progressively less palatable species, thereby reducing their frequency in the plant community. Certain grasses like *Dichanthium annulatum* and *C. ciliaris* show consistently high degree of palatability at all stages of growth. The high palatability of *Dichanthium* in early stages is endangering its continuance as a species as cattle tend to seek it out at this vulnerable early stage of growth in preference to other species. Similarly in a grassland dominated by a mixed stand of *C. ciliaris* and *L. sindicus*, the former would be the first to be overgrazed. Thus, in an overgrazed grass cover, there will be more species that the livestock do not like.

## Grazing in the Himalayas

The Himalayan region spreads over 12 states and covers a total land area of 61.5 million hectares. Of this, 17.8 million hectares is covered by dense forests and another 1.7 million hectares by alpine pastures, over two-thirds of which are in the state of Himachal Pradesh alone. These alpine pastures are the only true grasslands in India. They are found at altitudes above 2,500 metres to 3,000 metres, where the climate is severely temperate and prevents any growth of trees. But with the exception of these alpine pastures, grasslands in the Himalayas are generally the result of human interference, where overgrazing and deforestation have together led to the destruction of tree cover. At several places, the grasslands are very old, cover extensive areas and give the impression of being very stable natural formations. These grasslands are maintained by recurrent grazing, cutting and frost injury of invading tree seedlings. The bughials of Kumaon and Garhwal and the margs in Kashmir are good examples of such grasslands.

Grazing in the Himalayas is intense. The region supports 20 million cattle, 10 million buffaloes, 3 million sheep and 6 million goats. The western Himalayas, comprising of Jammu & Kashmir, Himachal Pradesh and the eight hill districts of Uttar Pradesh alone possess about 50 per cent of the cattle, 40 per cent of the buffaloes, 90 per cent of the sheep and over 50 per cent of the goats. The treeless sub-alpine and alpine pastures are extensively grazed during the summer and leading botanists point out that "we cannot even venture to suggest what species might be represented in truly climax formations there". In most parts of the Himalayas, the grass species found today represent the third or fourth stages of degradation, the fourth being the last stage of degradation. The present level of production of most of the Himalayan grasslands is about 25 per cent or less of their possible potential. Quality wise, they may be below 10 per cent to 15 per cent of their possible output of nutrients per unit area per unit time: so claim scientists at the Indian Grassland and Fodder Research Institute at Jhansi.

In the Himalayan region, forest floors are also extensively used as grazing lands. Besides this, forest-floor vegetation is repeatedly harvested for hay. Socio-economic surveys show that an average settled household in these regions keeps three animals (one buffalo, two bullocks or three cows). In addition, there are many nomadic graziers who migrate from the high altitudes towards the terai in the winters. In summer, this migration is reversed.

The grazing load appears to be greater on the lower 'chir' and 'banj' forests adjoining densely populated areas as compared to the higher altitudes, according to scientists at the Kumaon University. The availability of leaf fodder has gone down drastically in recent decades because of the replacement of broad-leaf varieties by pines and fir which have needle-like leaves and cannot be eaten by animals.

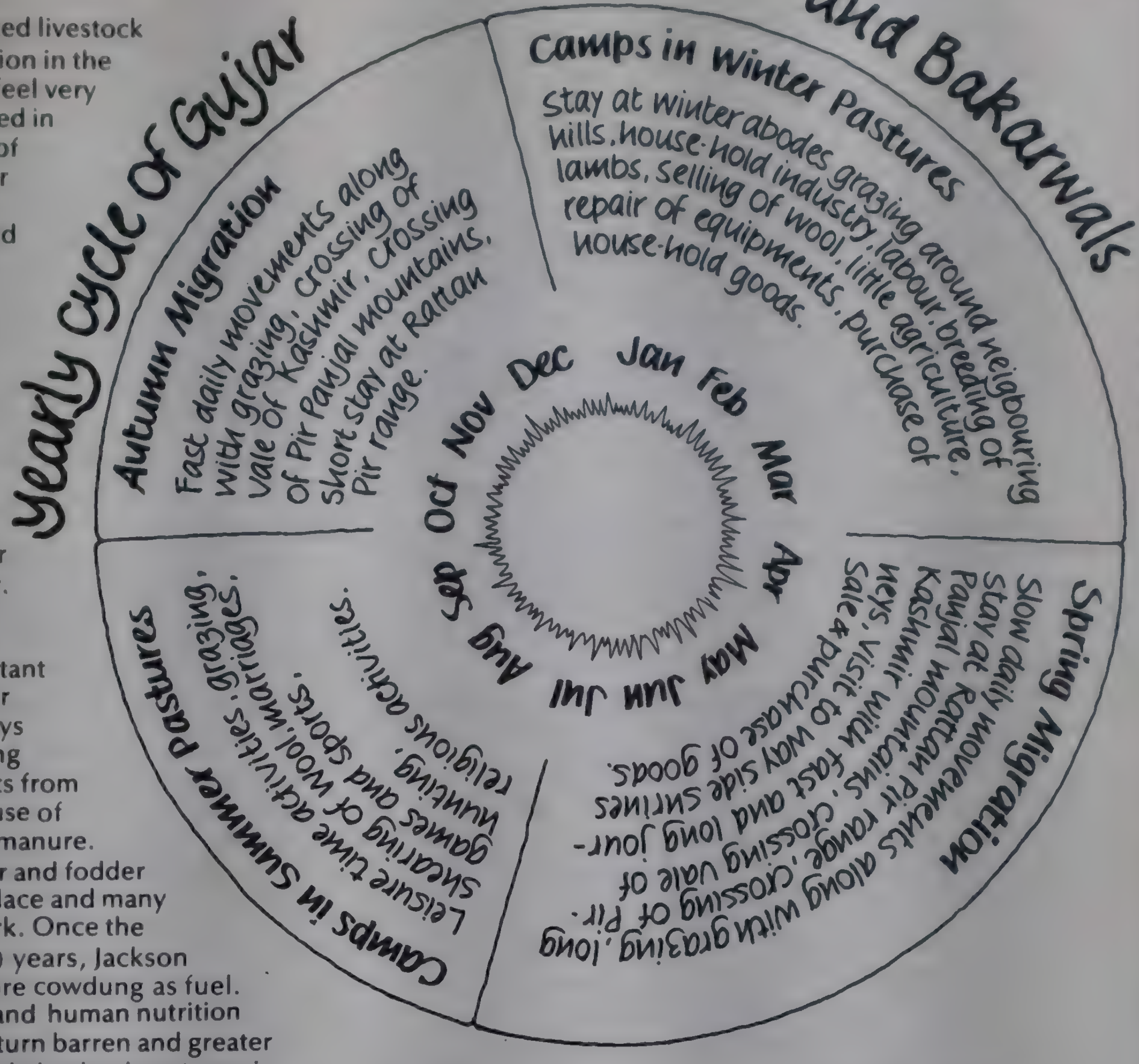
There is no accurate data on carrying capacity of the various types of forests and grasslands in the Himalayan region. But rough calculations made by various scientists during the mid-1970s showed that the animal population in Chamoli district was 2.4 times the carrying capacity of the local pastures and forests, four times in Chakrata tehsil and 4.5 times in Almora district.

The productivity of the animals is not suprisingly, extremely low. In areas like Ladakh, where pashmina goats are maintained, acute seasonal scarcities of fodder lead to a large number of animal deaths. Animals are very important sources of draught power and manure. Cowdung is an important source of fuel in hill villages but its use is limited compared to the plains.

### Thinning forest cover

In an interesting study of villages in Dwarahat block of Almora District, Professor M.G. Jackson of the Agricultural University at Pantnagar described the role that public

**Grazing in the Himalayas is intense. Nearly 40 million animals feed on its forests and grasslands suppressing regeneration of trees. (Ashok Dilwali)**


Yearly cycle of Gujar and Bakarwals
Autumn Migration
Fast daily movements along with grazing, crossing of Vale of Kashmir, crossing of Pir Panjal mountains, short stay at Rattan Pir range.
Camps in Winter Pastures
Stay at winter abodes grazing around neigbouring hills, house-hold industry, labour, breeding of lambs, selling of wool, little agriculture, repair of equipments, purchase of house-hold goods.
Spring Migration
Slow daily movements along with grazing, long stay at Rattan Pir range, crossing of Pir-Panjal mountains, crossing vale of Kashmir with fast and long journeys, visit to way side shrines. Sale & purchase of goods.
Camps in Summer Pastures
Leisure time activities, grazing, shearing of wool, marriages, games and sports, hunting, religious activities.
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lands like forests play in the integrated livestock farming system. Ecological degradation in the area is serious and most old people feel very definitely that forest cover has thinned in their own lifetime and the number of springs drying up during the summer has increased. Most of the reserve forest area of the block is now devoid of trees. Whatever trees are present are almost all pine. Fuel comes mainly from small tree branches, split pine and sticks and from weeds like lantana that have spread in recent years. Home production of foodgrains is no longer sufficient and has to be supplemented by purchases from the market. On an average, home-produced foodgrains are enough for only about seven months of the year.

Within the hill-farming system prevalent in Dwarahat villages, the uncultivated land plays a very important role. This land acts as a free fertiliser and energy factory and livestock plays the role of collecting and transferring nitrogen and other mineral elements from this factory to cultivated lands because of the widespread use of cowdung as manure. Today, the extraction of fuel, timber and fodder is more than the ecosystem can replace and many people migrate to the towns for work. Once the remaining trees are gone in about 10 years, Jackson guesses people will begin to use more cowdung as fuel. Crop yields will fall further, animal and human nutrition will suffer even more, the land will turn barren and greater human migration will take place. As irrigation is not easy in these parts, even Green Revolution technology will not be able to help much.

Yet, on the other hand, ecological restoration can change the situation dramatically. Jackson proposes a multi-pronged strategy, the first element being stall-feeding. If animals are stall-fed and fodder is cut and carried to them, the carrying capacity of the grazing land increases. Moreover, more dung could then be collected and applied to the cultivated lands as none would then be lost in the forests. The second element is rehabilitation of public lands with fodder and fuelwood plantations, whose productivity can be easily doubled, if not more, by proper management.

But to get the villagers to manage these public lands well, Jackson argues that land must be transferred to them. There is an average of 93 hectares of reserve forest area per village in this region. About 50 hectares of this land can be easily transferred to each village. The third element in Jackson's strategy is the introduction of higher efficiency woodstoves.

But probably the most difficult part of Jackson's strategy is that the livestock in the village ought to be managed on a community basis so that individuals do not increase livestock numbers with the increase in the availability of fodder. Moreover, he suggests, to keep the livestock population constant, villagers will have to cull calves to keep their numbers to a level which is just enough to replace existing livestock numbers. This culling takes place even today, simply through starvation, high mortality and a high rate of abortions, but whether planned culling would be acceptable to villagers is a matter of great doubt.

**Migration routes**

Large numbers of livestock are also kept in the Himalayas by nomadic groups and their problems are relatively different from those of the settled populations. The Bakarwals and Dodhi Gujjars of Jammu and Kashmir are fully nomadic and are ever on the move, though many of them have also begun to settle down by acquiring land along their former migratory routes. The Bakarwals mainly keep sheep and goats whereas the Dodhis keep buffaloes. These nomads enter the Kashmir mountains in summer through the Pir Panjal range and finally reach the high mountains north and northeast of Kashmir valley, where their summer pastures are located in mountainous areas like Sonmarg, at a height of 10,000 ft to 15,000 feet.

They depart from these pastures in early winter to move down to the warmer areas in Jammu. Keeping their herds away from the cultivated fields during the winter season is difficult. Also at this time there is great risk of conflict with peasants and land owners, if the nomads remain too long in the winter pasture zone.

The Bakarwals are on the move for 100 days to 250 days in a year and cover sometimes as much as 2,000 km. They live in a closed community and camp in seclusion. The agricultural and industrial products they need are obtained from settled villagers. Normally, villagers will leave their goods with the encamped graziers and a week or so before their departure, the villagers will come to settle accounts. Payment is made by the nomads mainly in butter, cheese, hides and rugs.

In recent years, there has been an increasing tendency for wealthier Bakarwals to convert a fraction of their livestock wealth into landed property. There is now an active land market along their migration routes. This land provides them with secure wealth and an annual income from agricultural produce.

The Gujjars of Kashmir are more numerous in number than the Bakarwals but they lead a semi-nomadic life, like the Gaddis of Himachal Pradesh. In winter, they live in huts perched high up in the mountains. During summer, they move around and live in tents. They usually own some land too and most cultivate maize. The total population of these nomadic and semi-nomadic groups in Kashmir is estimated at 2.5 million to 5 million. Few animal husbandry programmes have helped these nomadic groups as they have mostly been aimed at livestock owned by sedentary populations.

states. It also provides sturdy draught animals. Rajasthan today boasts of the best livestock breeds of cattle, sheep, camel, goats and even horses. For instance, although the state's sheep population is about 16 per cent of the country's total, it produces about 45 per cent of the country's wool.

The livestock population has steadily increased in the last 30 years. While the number of cattle, buffaloes and sheep increased by 25 per cent, 72 per cent and 100 per cent respectively, between 1951 and 1983, the number of goats shot up by 238 per cent. Thus while the number of goats was about half the number of cattle in 1951 by 1983 it was 40 per cent more. The rapid rise in the goat population has alarmed many environmentalists. The goat is often considered harmful for soil conservation because it consumes all ground vegetation. It is accused of seriously increasing the aridity and lowering the productivity of arable land. Some countries have even enacted laws to force a decline in the goat population.

In reality, however, human beings are to blame. Heedless cultivation, the neglect of fallows, the crowding of all types of livestock onto decreasing areas of lower quality grazing, have lead to the disappearance of larger and potentially more productive livestock, and have left the more frugal goat to take all the blame. The goat alone can survive in this highly degraded environment and represents much less risk for the poor peasants than cattle.

In these pastures, both the production and quality of grasses are becoming poorer every season because of indiscriminate grazing and poor management. The gram panchayats seldom take any interest in the management or development of pastures. Nearly 1.81 million hectares are recorded as permanent pasture land for grazing in Rajasthan and most of these lands are under the care of gram panchayats.

The forest department collects and auctions the grasses which grow on the pasture lands it manages, and a portion is kept in reserve for feeding livestock in scarcity periods. A few well-managed pasture lands are open for grazing at a nominal fee but there are always conflicts between villagers and forest staff regarding their use.

**Common lands**

In a detailed study of the deterioration of common property resources in Rajasthan, economist N.S. Jodha points out that easy and unrestricted access to land resources other than one's own is what makes livestock breeding more profitable than crop farming in a climatically unstable environment. Under the traditional pasture-based system with limited stall feeding, feeding and watering accounted for the bulk of the rearing cost of animals. As a result non-land owning households have a higher average number of animals than many land owning households. In other words, common property resources for animal husbandry enable the poor to eke out a living.

But common lands are getting degraded all over the state. The common land decline is taking taken place largely through reduction in area, negligent upkeep and maintenance and the slackening of formal or informal regulations. In the 11 districts of the arid zone, grazing areas have declined consistently since 1951–52. The decline was greatest during 1951–52 to 1961–62, the era of land reforms. One consequence was the increase in animal density, from 39 animal units per hectare of grazing lands in 1951–52 to 105 during 1977–78.

**Changes in extent of common grazing lands[1] in the arid zone of Rajasthan**

| | 1951-52 | 1971-72 | 1977-78 |
|---|---|---|---|
| Area of grazing lands (million ha) | 11.3 | 9.2 | 8.7 |
| Share in total geographical area (%) | 60.5 | 47.9 | 45.1 |
| Animal Units per 100 ha of common grazing land | 39 | 94 | 105 |

[1] Grazing lands include, permanent pastures, uncultivable wastelands, culturable wastelands and fallow lands other than current fallows.

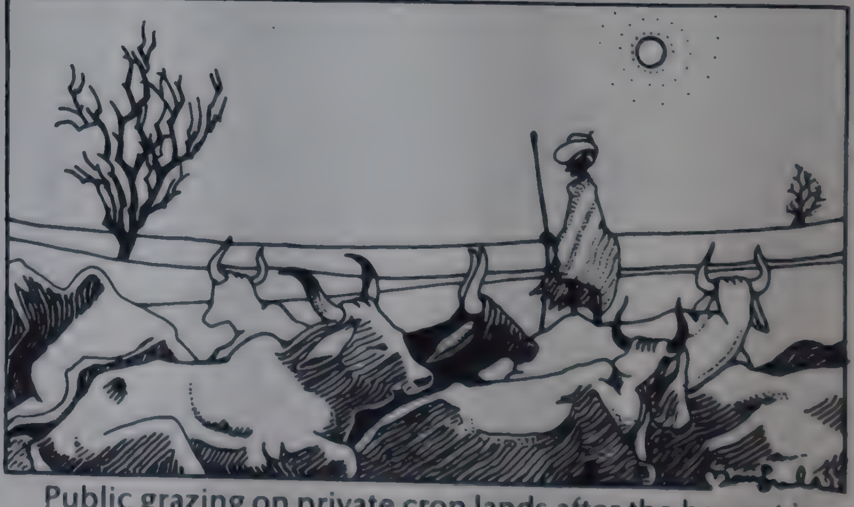
Source: Statistical Abstracts of Rajasthan for different years as quoted by N.S. Jodha.

Large-scale conversion of public land to private use followed the land reforms of the early 1950s, without any thought to the suitability of most such land for crop farming. Forests and permanent pastures, already small in size, suffered the most because of a fall in crop land under fallow rotation which in turn increased animal pressure on them. Later, extensive use of tractors also led to decline in old fallows.

Forests and permanent pastures in these villages were traditionally under grass, bush or trees not because nothing could be grown on them, but because the jagirdars used them to graze their horses. During the land reforms, several influential people in the village managed to grab such lands for themselves.

Stock watering points are of crucial importance for pasture-based animal husbandry as even the best of grazing lands cannot support livestock unless complemented by adequate water facilities. Locally known as nadis (or nadias, if small) and tobas, these watering points (ponds/tanks) are scattered in various parts of the grazing areas.

Jodha found in two Rajasthan villages that the number of watering points declined dramatically during the 1960s. The small and heavily silted ponds with small catchment areas and limited waterholding capacity have largely disappeared. Neighbouring farmers managed to prove them part of their holdings and ploughed them (see water chapter).



Public grazing on private crop lands after the harvest is an important informal arrangement helping graziers, providing better forage than pastures and uncultivated lands: crop leftovers, undergrowth of crops, resprouting of harvested crops as well as bushes and top feeds from trees. However, despite an increase in the net sown area in the arid region the contribution to total forage supplies seems

## Holy Cow?

The subject of cow slaughter never fails to arouse passions in India. The usual perception of the situation is this: there are too many undernourished, underproductive cows in India and the lot of the cow population as a whole would be improved if a substantial percentage were "disposed off". The biggest obstacle to this efficient solution is seen to be Hindu religious sentiment which decrees that the cow is sacrosanct.

The controversy about excess cattle being generated by Hindu religious sentiment was triggered off by a paper by economist V.M. Dandekar in 1964. Dandekar examined the data yielded by the 1961 livestock census for Maharashtra. He found that until the age of three, the number of cows was equal to the number of bullocks; at the adult stage, however, cows were 20 per cent fewer than bullocks. This was not the result of culling but pure starvation: bullocks got good fodder to eat, while cows got only the residues.

Dandekar concluded that the problem of numbers was more fundamental than that of old and stray cattle; he worked out that only 40 per cent of the cows were required to produce the necessary number of bullocks and the remaining 60 per cent ought to be disposed off by a process more efficient than starvation. He finished by stating that it was simply hypocritical religious sentiment that stood in the way of livestock development.

Other researchers picked up the gauntlet. Economist Marvin Harris pointed out that even seemingly useless animals might have a use as producers of milk and dung. In fact, there was an acutely felt shortage of draught animals. Harris said that there were sensible explanations for most aspects of the cattle population which were not based on religious sentiments at all.

Other economists concurred with Harris. K.N. Raj developed two livestock models, one for a high-income developed economy and another for a low-income developing economy. If religious considerations were a factor then they should have affected the models, created from authentic data, but no such divergence was noted. Raj then wrote another paper in which he pointed out that Kerala had 167 adult cows for every 100 bullocks while Bihar had 67 and Uttar Pradesh 47. If religious sentiment had anything to do with it, Kerala's predominantly non-Hindu population would have preferred bullocks to cows and Bihar and Uttar Pradesh would have shown less neglect of their cows.

More recent papers by A. Vaidyanathan, K.N. Nair and Harris have analysed regional variations in cattle-sex ratios. They conclude that the ratios "correlated with factors such as human population density, size of holdings, agro-climatic conditions, crop regimens, bovine breeds, degree of development of the urban milk market and inter-state trade, but not with religious or caste identities". The sex ratio—males per 100 females—of adults increases with an increase in human density up to a certain extent and declines at very high levels of human density. They explained the drop in the number of cows at the adult stage—noted by Dandekar—by stating that calves were necessary for milking the cows in the first year. The culling of unwanted females in their infancy would reduce the milk yields of their mothers.

But religious beliefs probably do have a role to play in the cow story, as 1979 studies of Kerala by Nair have shown—though not quite in the way expected. The number of bovines slaughtered in the state rose by 65 per cent within a decade, the average life of the adult cow reduced by 35 per cent and that of the male by about 11 per cent. The reason is not far to find: fish has become too expensive and the demand for milk and beef has risen leading to a reduction in the draught animal stock. Selective slaughter has helped Kerala supply hides and skins for Tamil Nadu's leather industry while Tamil Nadu exports its surplus cattle to Kerala. All this is possible because the state does not have a Hindu majority and religious feelings do not come in the way of the marketplace.

The ban on cow slaughter is one of the directive principles of state policy in the Constitution and has been legislated in all states except Kerala and West Bengal. As studies show, farmers with holdings below 0.5 acres have twice as many cows as they have males, which shows that cow slaughter would affect most the very people who depend on the underfed animals for a living, however meagre. Thus, legally, economically, and logically, cow slaughter is not a feasible proposition—which should gladden the hearts of all those who feel that only their cries in the name of God come between the cow and the knife.

R.K. Sharma/Indian Express

to have declined. This probably a is result of large-scale tractorisation. In the arid districts the number of tractors almost tripled in a decade from 2,251 in 1961 to 6,652 in 1971.

The management of common land and water resources has also deteriorated with time. People tend to overexploit them without any restrictions. Estimates based on detailed investigations in some villages of Nagaur district revealed that prior to land reform the animal grazier had to pay in cash or kind (at 1976–77 prices) Rs 41 per household, besides Rs 1.25 as grazing tax (ghasmari) per animal per year. After land reforms no payment is needed. Moreover, there are no institutional means to regulate the use of common lands. It is ironical that feudal authorities managed common property resources better than the present day democratic administration, says Jodha. But most feudal provisions regarding these lands were designed to generate income for the feudal lords.

**Four options**

With the degradation of common resources, villagers have four options. They can travel more and more to resource-rich areas; they can reduce herd size; they can change the composition of animal holdings to gain more from common lands; or they can reduce dependence on common resources even if doing so increases the private cost of livestock rearing. People are adopting all four options.

The process of change in composition of livestock is quite interesting. Until 1955, the villages studied by Jodha had five to 17 households who had herds (tolas) of camels. Following land reforms, when the process of deforestation was accentuated, camel herds started disappearing, as they survived mainly on top feed. By 1963–64, except in Jaisalmer villages, there was no household with even three camels.

The next category affected was cattle. Until 1955, in the study villages there were 23 to 60 chhangs (cattle herds with more than 25 adult cattle). By 1963–64 with the decline in the grazing resources, there were only six.

The composition of the cattle herd also changed, partly because of the new milk marketing facilities. The number of unproductive cattle (dry stock and young stock) per milking animal declined; but the proportion of buffaloes to total cattle increased. The private cost of maintaining cattle increased as more cattle had to be stall fed and given water from private sources. Also farmers realised that it is more profitable to have regular milk supply from a well managed, smaller number of animals than depend on unstable and low production from a large number of animals surviving mostly on common lands.

Meanwhile, sheep and goats have also become more acceptable. Sheep and goat raising in Jodhpur and Nagaur villages was the traditional occupation of low caste and semi-nomadic groups. But it has slowly become popular even with high caste groups. Consequently, nearly 10 high caste household in the study villages had adopted sheep and goat raising in 1963–64 where none had done so until 1955.

**Nomads in Rajasthan**

Animal husbandry and nomadism are probably the most secure occupations in a harsh climate. During a drought year agriculture production may fall to less than 10 per cent of the production of a favourable year, but the production of milk and wool is still over 50 per cent of a good year.

In normal years when adequate rainfall ensures a sufficient supply of grass, livestock graze near the village or within a radius of 25 km to 33 km. But in scarcity years flock owners move towards Punjab, Gujarat, and Uttar Pradesh. Movements are organised in groups of families.

They follow the routes taken by their ancestors', although they find it increasingly difficult. The end points touched by these migratory households are towards Malva in Madhya Pradesh and the Rajasthan–Uttar Pradesh border, that is, Kota, Agra, Hathras, Aligarh and so on.

The nomads of the arid zone are not a separate ethnic group and have in the past had a close symbiotic relationship with the settled population. Based on Central Arid Zone Research Instutute (CAZRI) studies the nomadic groups of Rajasthan's arid zone may be broadly grouped in four categories: the pastoral nomads (Raikas, Sindhis, Parihars, Billochs, etc.); the trading nomads (Banjaras, Ghattiwal Jogis and Gawariyas); the artisan nomads (the Gadolya Lohars, Sansis and Sattias); and others (Nats, Kalbeliya Jogis).

Nomads claim that rapid changes have taken place over the last 30 years. Earlier, local farmers usually requested livestock owners to rest the animals in their fields for the manure, paying them a toll of some rupees per night. Sometimes, the farmers provided rations in exchange for the manure. But this symbiotic relationship is breaking down.

In recent years the nomads have often been considered a menace by settled people. Villagers no longer depend upon those nomads who rendered specialised services. Feelings run strongest against the visit of nomadic groups which have large herds of cattle (Raikas, Sindhi cattle breeders) or who are commonly believed to be associated with theft (Sansis, Sattias and Nats), while Gawariyas, Ghattiwal Jogis and Gadolya Lohars are more welcome.

**Nomadic movements**

Dr L. P. Bharara of the Central Arid Zone Research Institute (CAZRI) has made a detailed study of villages under the Guhiya catchment of the Upper Luni basin of Rajasthan. The catchment comes under an arid climate and experiences wide fluctuations in temperatures. Livestock migration is adopted by these villagers as a means to combat drought. Between 1958 and 1980, migration took place for 15 years; more than 10 per cent of the households surveyed had migrated. Thus during drought or famine years, 28 herds consisting of 12,800 heads had migrated.

About half the livestock from the Rajasthan desert still migrates soon after November every year. During drought years the migration starts early in September and nearly 90 per cent to 95 per cent livestock migrate out of the desert region. The animals return in July the next year. The availability of fodder in Rajasthan is sufficient to support only 87, 79 and 48 per cent of the present livestock population during a good year, normal year and a drought year.

According to the figures given in the 1977 cattle census, during the years 1968–69, 1969–70, 1972–73 and 1974–75 there were fairly large-scale migrations of livestock from one district to another within the state and outside the state, the maximum being during 1969–70, when nearly a million animals migrated from the various districts. From then most of the livestock have been migrating to the neighbouring

Pastoral nomads account for six per cent of India's population. But few programmes have been started to meet their acute fodder needs. (Bhalu Mondhe) states of Madhya Pradesh and Gujarat. This more recently has led to inter-state problems and disputes. Migration is fraught with great hardship. Some animals die during the journey from starvation and a large number have to be sold at distress prices en route for purchase of items of daily needs.

Sheep migration is common in the arid western districts of Jaisalmer, Barmer, Jodhpur, Pali, Jalore, Nagaur and Bikaner. About 30 per cent of the sheep population in Rajasthan is maintained on a migratory basis. According to an estimate, about 0.6 million sheep are permanently on the move.

**Drought and scarcity**

Substantial areas of India are expected to face drought conditions once every four to five years. In drier areas, such as Rajasthan, Gujarat and Andhra Pradesh, droughts occur once every two or three years. Western Rajasthan is expected to face drought every 2.5 years. In terms of geographical area, drought-prone regions represent about 19 per cent of the total area of the country and nearly 12 per cent of its population. Relief measures are far from satisfactory. Between 1979 and 1982, out of a total of Rs 184 crore provided to Rajasthan, a chronically drought-affected state, the amount spent on cattle and fodder was only Rs 15 crore.

Droughts lead to scarcity of foodgrains (akal), water (jalkal), fodder (tinkal) and often of all these (trikal). The subsequent famine leads to mass migration of humans and livestock. During the famines of 1868-69 in the Thar desert, all the villages between Jodhpur and Pali (65 sq km) were abandoned. In the famine years ranging from 1812 to 1940, 30 per cent to 80 per cent of the livestock population died. Owing to continued droughts during the 1967-71 period, and with the subsequent migration and mortality, the number of hardy goats increased substantially by 34 per cent.

The first relief measures during drought are intended to

### Close Encounters ...

Nomadic shepherds and their animals are increasingly unwelcome visitors to other states. A case in point is that of Madhya Pradesh, where several clashes between nomads and foresters have been reported. Not surprising, since, according to official estimates, one million sheep, goats, camels and cattle from Rajasthan graze in Madhya Pradesh forests every year.

Livestock from other states passing through Madhya Pradesh are given transit passes, and the shepherds are supposed to ensure that their animals do not linger on to graze. However, following complaints that the transit passes were being abused, the Madhya Pradesh government in 1979 drastically amended rules: it prescribed a steep grazing fee of Rs 25 for 'outside' sheep as against Re one for 'local' sheep, and fixed a limit of 45 days for livestock to pass through the state.

The nomads went to court, arguing in a writ petition before the Supreme Court that the order constituted a breach of fundamental rights and was discriminatory in several other ways. In May 1983, the court decided in their favour, upholding their right to graze cattle, sheep and camels in transit to other states and holding the higher charges for 'outside' animals unconstitutional. The court remarked that "no Indian is a foreigner in any of the constituent states", "it cannot be that the Madhya Pradesh cattle are less destructive than the cattle belonging to persons of other states", and that the higher rates only favoured the rich. The court also struck down the 45-day rule but held the government's prescription of a route for the nomadic livestock as a reasonable restriction.

The tension continued, however. In August 1983, a contingent of 70 forest officials swooped down on a group of shepherds, Rewaris from Gujarat, grazing their herds in Khandwa district. The operation lasted six hours, left 185 sheep dead—the Rewaris claim 250—and two injured shepherds. The foresters claimed the shepherds were there illegally. The shepherds charged they had applied for transit passes two months earlier but the forest department had refused to issue them without bribes. One shepherd told a reporter: "Last year we paid Rs 5,000 extra to get 8,000 passes."

Later in September 1983 the Mandsaur district administration braced itself to prevent the entry of one million sheep and camels from Rajasthan. The warning came in a wireless message from Balkavi Bairagi, Congress(I) MLA from the area and a former minister. The arrangements for the counter-offensive included the deployment of a platoon of the special armed forces and a contingent of home guards.

With the increasing pressure on available grazing land, however, it is clear that more civilised solutions to the problem—if problem it is—will have to be found. For time is running out for the nomads and their animals on both sides of the border.

### ... And Counter-Arguments

Following severe criticism in the press over the mass killing of sheep by forest officials in Dahinala, Balkavi Bairagi, an MLA from Mandsaur wrote an angry article to the Indore daily Nai Duniya. His views are a very good example of the new response of settled populations to the nomads, with their traditional ties and relations rapidly breaking down. Excerpts from Bairagi's letter:

"My own district, Mandsaur, borders the state of Rajasthan. You will find, not one or two, but three to four lakh sheep grazing in the forests here. Life has become extremely difficult for the farmers. Their crops get destroyed. Last year I had to insist with the government that police and security forces like SAF be provided for a whole month. Then only we could be liberated from the death-dance of these sheep.

"You can imagine what can happen when lakhs of sheep invade your standing crops for miles. Village after village begins to weep. Have you ever seen the preparations made by these Rajasthani shepherds to graze their sheep? They never travel alone. Fifty families travel together. They not only have guns, axes and lathis but also traditional weapons like 'gophan'. This lump of interwoven rope is often more deadly than a gun. It is used to throw stones and if the aim is accurate, it will break your head. Round stones are thrown with it and its effectiveness depends on the user. Good gophan-users can split the head of their victim half to three-quarters of a kilometre away. Our villagers are more afraid of the gophan than the gun. A whistling stone comes from an unknown direction and destroys its victim. Apart from this weapon, these shepherds have domesticated wild dogs, trained to hunt. An even more powerful weapon is their purse full of notes. The most powerful weapon, however, is their arrogance: 'We have left our house only to die. Who ever has drunk their mother's milk can come forward in front of our gophan.'

"If you were to see the patels (head person) of these nomadic groups you will get a vision of medieval lords. If a government official is able to arrest an odd group, then the head of the group will not come walking to meet him. He will either come on his camel or in his palanquin. An armed force will move with him: women armed with gophans, young men with guns and 50 pet dogs all around. The entire scene is so full of terror that either the man in front will faint or run for his life. These people believe that the sitting or getting down on the ground of their patel, dressed in colourful medieval clothes and bedecked with a big beard and moustache, as an equal to the person in front, is an insult to the clan-goddess. The patel shouts from afar: "Speak, what is your price? What is the price of your ranger? How much do we have to stick on to your DFO's beard? How hungry is your MLA? What scales do you want to weigh your minister in notes?"

keep human beings alive and are only later addressed to the livestock. But as livestock which is often the only capital and source of income of the herders, their spontaneous reaction is to migrate towards areas where they can find feeds. This may bring difficulties of different types, both for the inhabitants of those areas and for the migrants if these mass movements are not prepared and are carried out in a disorderly fashion.

As intervals between serious droughts are relatively short in India, the government has devised a plan of intervention along the routes followed by migrants: in case of emergency drought, feed stores and water are supposed to be put up every 20 km along the evacuation routes. These services and foods are supplied free (6 kg of hay per head of cattle, 0.5 kg of flour per person per day) upon the production of an identity card by stockbreeders indicating the number of animals they own. Protected forests play an important role as suppliers of hay for fodder centres during drought years.

The government recognised the importance of feeding livestock during scarcity in 1939 when the country was faced with a severe drought and shortage of livestock feeds. A survey of the famine stricken areas recommended the maximum use of unconventional feeds and crop residues. Research centres are working on cheap economic rations and ways to tackle emergency situations arising out of drought or floods.

Beginning with the 1972-73 Maharashtra drought, techniques generated from this project helped feed animals in relief camps in several cases of drought. Cattle, buffaloes and other ruminants were fed with urea-molasses, impregnated bagasse-straw.

During scarcity, since supply of fodder/feed from within the state becomes scarce, the only alternative often is to import fodder from outside the state. The problems of logistics and huge costs involved in transportation of fodder are major constraints in providing effective protection to livestock. In earlier years, adjoining states like Madhya Pradesh and Gujarat used to allow cattle from Rajasthan and

"The first thing these people do on entering the forests is to announce that they will break the head of the local sarpanch. They become thirsty for his blood. If you were to feed a sheep with your own means, you will incur an expenditure of Rs 2 to Rs 4 every day. This practice of free grazing on government pastures and forests and farmer's fields by showing the lathi has always brought great economic advantages to these shepherds. In such a situation, if they have to pay a quarter or half a rupee, or even a rupee or two, they are prepared to throw the money in your face. Without any shame or embarrassment, they begin to believe that everything belongs to their forefathers, the government can be bought and the farmers' fields have been spread by God himself for their sheep. If the price cannot be negotiated, then there are gophans, dogs, lathis and guns, and finally newspapers and courts.

"Last year I had about 5 lakh such sheep removed from my area. This year, at the time when the sheep were being massacred in Dahinala, policemen, panchayat and forest officials in my area were trying to rid farmers' fields of about one lakh sheep. Even Mandalgarh, the area from which Rajasthan's Chief Minister Shiv Charan Mathur comes from, has been terrorised by sheep. During the period of the Janata government, Mathur himself was the chairman of the local 'Remove Sheep Committee' (Bhed Bhagao Samiti). Half a dozen shepherds were killed by the local farmers that year and the Shekhawat government had filed a police report of serious offence against Mathur.

"At the moment of my writing these words, there are about 10,000 sheep grazing in my area in full freedom. Some have been chased back into Rajasthan. Some have run into Saklecha's area. This year, one forest official did an amazing thing. This petty forest official had made sufficient preparations for bloodshed all along the Rajasthan-Madhya Pradesh border. This great incarnation of God, after taking one rupee per sheep, ten rupees per camel and five rupees per donkey, gave grazing permits to thousands of sheep to graze anywhere in all of Madhya Pradesh. Grazing was permitted not just for 10 or 20 days, but uptil 1984. These permits are invalid and illegal. But when the forest officials and policemen on my insistence went to act against the shepherds, they threw these permits in their face.

"For a whole fortnight these nomads terrorised the place. They even did criminal things like snatching money from people walking along the roads and snatching rotis from mothers and sisters going to the fields. They began to hunt for every sarpanch and threaten him with his blood. The terrorised villagers came to me. I met the local district magistrate and superintendent of police. It was fortunate that I found two officials who fully understood this problem in Mandsaur district. They helped us fully. Even today a police patrol is active.

"You may or may not know, but these grazing and transit passes do not give permission for grazing in reserve forests. But once inside the forest, who knows what is a grazing forest and what is a reserve forest? Permission is granted to 10,000 sheep but 2 lakh sheep enter. If you can count, you are welcome to do so. They will point towards the sheep grazing for miles in forests and farmed fields and say: 'Eight thousand are already grazing here. Another herd of 2,000 will come in a day or two. Why don't you come back then and count?' Few people know how difficult it is to count lakhs of sheep in a forest. Even more difficult is the behaviour of the sheep. This is a very obstinate animal. It obeys its master's orders with its life. This animal sits or walks only on the commands of its master. If the shepherd has asked it to sit, then it will give its life, but it will not get up. Forest officials and villagers kill it only in their bid to pick it up or remove it. The shepherd simply gives the sheep his command and sits down to smoke his hookah in peace."

FAO

other drought stricken states to graze in their forest areas. Of late these states have tried to impose restrictions on entry of animals from other states. This has created problems for the nomads of Rajasthan (see box).

**Periodicity of drought in different parts of India**

| | | |
|---|---|---|
| 1. | Assam | Very rare, once in 50 years. |
| 2. | West Bengal, Madhya Pradesh, Konkan, Andhra Pradesh, Karnataka, Maharashtra, Orissa, Bihar & Kerala | Once in 5 years |
| 3. | Eastern UP, South interior Karnataka, Vidarbha | Once in 4 years |
| 4. | Eastern Rajasthan, Gujarat, West UP, Rayalaseema, Tamil Nadu, Kashmir | Once in 3 years |
| 5. | Western Rajasthan | Once in 2.5 years. |

Source: Report of Task Force on Integrated Rural Development, Planning Commission (India) 1973.

## Option for the future

The slow destruction of the country's grazing lands has created serious problems for the management of India's vast animal population. Particularly affected are the nomadic populations. Experts meeting at the UN Conference on Desertification in Nairobi in 1977 agreed unanimously that nomadism and transhumant animal husbandry is the best possible productive system from an ecological point of view for the use of fragile ecosystems in arid and semi-arid areas.

The Government of India, however, does not appear to have accepted this wisdom. It has no real policy for helping nomadic groups adjust to the changing environment or to help them improve it. The general attitude of most government agencies is to devise ways to settle these groups. "The nomads in the present day society prove a menace for the whole society and their sedenterisation is inescapable," states the Department of Environment's 'State of India's Environment' report. Government policies, ecological destruction and growing hostility from the settled populations have forced many nomadic groups to give up nomadism and become landless labourers.

Meanwhile, the natural balance that once existed between environmental resources and stocking rates is now being disturbed. Environmental resources available to nomads have thus diminished noticeably because of inadequate government policies to protect grazing lands and active government policies to push crop production on marginal lands. To ensure their own survival livestock breeders have responded by increasing their animal populations and keeping more browsers. The result is heavier destruction of grazing lands and pressure on forests. The government, therefore, faces its biggest challenge in determining the future development strategy for its nomadic groups and in restoring the country's grazing lands to health. But politicians at all levels—from state chief ministers to union cabinet ministers—have no understanding of the problems of nomads and would prefer them dead and gone.

In the past sporadic efforts have been made in different parts of the country to increase fodder production, by farmers on private lands. Work on breeding and economic aspects of fodder and pasture species was initiated at the Indian Agricultural Research Institute (IARI) at New Delhi in 1953. Research on fodder crops received further impetus with the establishment of the National Dairy Research Institute (NDRI) at Karnal in 1955 and the Central Arid Zone Research Institute (CAZRI) at Jodhpur in 1959. The Indian Grassland and Fodder Research Institute (IGFRI) was set up at Jhansi in 1962. A coordinated project on fodder crops was started in 1970 by ICAR with eight regional centres and six subcentres covering different agroclimatic regions. Agricultural universities located in different states also conduct some research on fodder crops.

Since the average holding is small, all the regional stations aim to incorporate fodder, particularly legumes, into existing crop rotations. Seeds of high-yielding varieties of fodder crops, now available for each region, are supplied by regional stations.

But almost nothing has been done about afforesting public lands with fodder species and regenerating grasslands. Degraded grasslands contain a large proportion of non-edible shrubs. The IGFRI at Jhansi has found that the removal of the shrubs alone results in an increase in forage production of 1.2 tonnes to 4.2 tonnes per hectare per annum. Silvipastoral experiments have indicated that fodder-cum-fuel trees like leucaena, grasses and legumes can play a vital role in improving production of forage, fuel and grain.

Stall feeding has been repeatedly recommended by experts to stop ecological destruction caused by indiscriminate grazing, but this is clearly impossible unless there is a massive fodder production programme. Animal husbandry is a state subject. Fodder development is a low priority in state plans. During the Fourth Five Year Plan, feed and fodder development received 4.2 per cent of the allocation under animal husbandry, but during the Fifth Five Year Plan the figure was 2.9 per cent.

### Immense prospects

The potential of grazing lands is immense in India. In western Rajasthan, for instance, vast areas are available which are not suitable for agriculture. The total area classified as culturable wastelands and permanent pastures in the 11 districts of western Rajasthan is estimated at 9.47 million hectares and 4.56 million hectares, respectively. This area, even if moderately developed, can support a large livestock population.

The NCA had in 1976 recommended that "green fodder production is the most important single factor on which will depend the success of the animal husbandry programme", that all unoccupied land should be planted with trees and bushes or seeded with self-regenerating grasses and legumes.

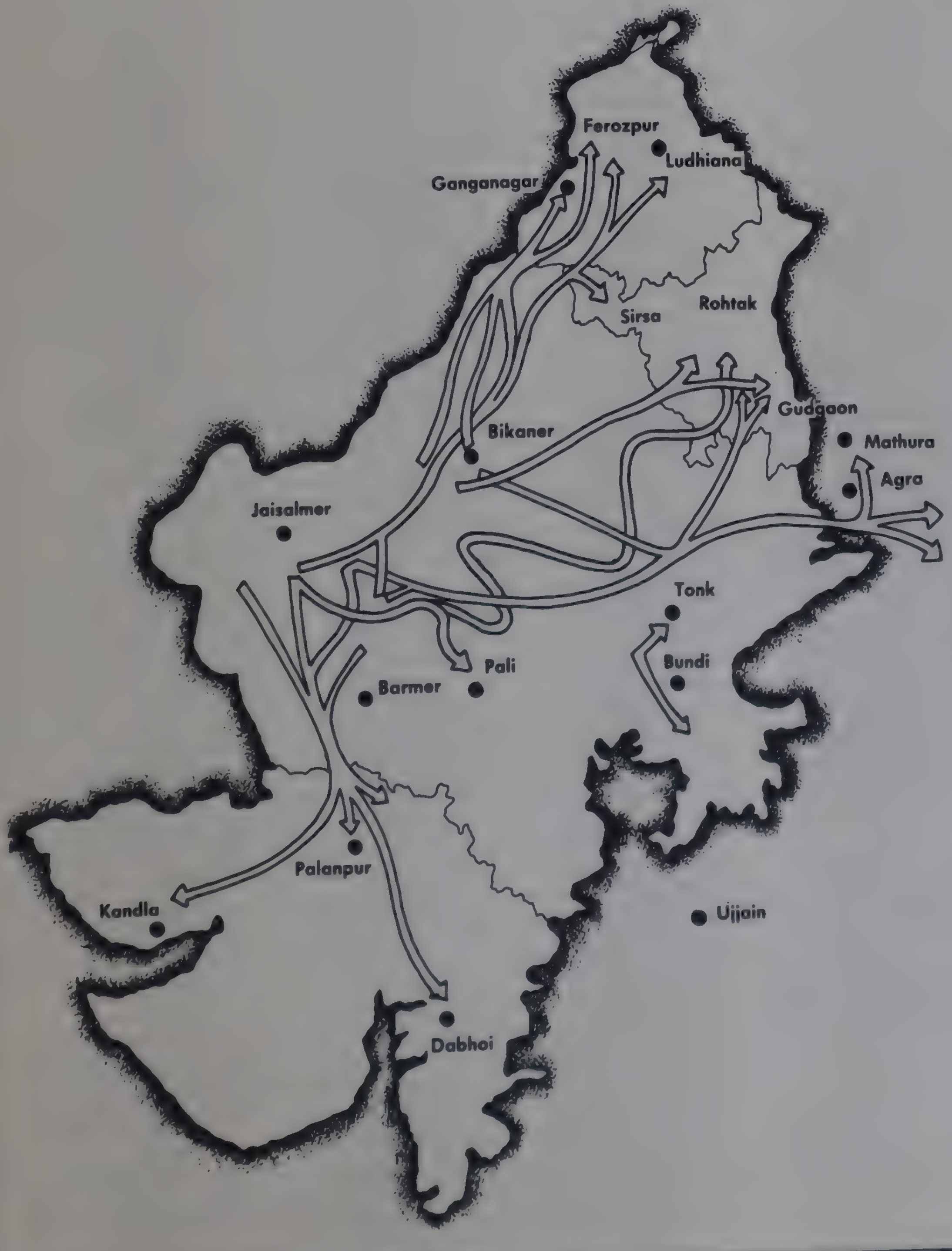
Social forestry programmes in arid and semi-arid areas should be based on fuel and fodder species. Ironically, government agencies and farmers are keen on a non-browsable species like eucalyptus specifically because animals do not eat its leaves. In all semi-arid areas, eucalyptus is now being planted. In many villages, social forestry programmes have been opposed because poor people (especially those with cattle but no land) are afraid that their grazing lands will diminish.

The Rajasthan forest department has started a programme for pasture land development through controlled grazing under the Desert Development Scheme. Since 1974, 311 village panchayats have been assisted in developing their grazing lands. The forest department plants suitable grass species and appoints a guard. The grassland is divided into two separate enclosures. After four to six months when the grass is big enough to be grazed, the department opens one enclosure and the sarpanch is told the number of livestock which can graze in a specified period. The guard is expected to regulate the grazing and collect the money from cattle owners, which is then given to the panchayat. This revenue covers the cost of production and maintenance of these pastures. The cost of maintenance comes to about Rs 400 per hectare, which the panchayat pays, while the forest department develops the grazing land initially.

Dr M.B. Mathur, director of afforestation and pasture-land development in Jodhpur, says "This scheme has been functioning very well because of the villagers' full co-operation." This is despite the fact that pasture lands are closed for regeneration at a time when fodder scarcity is quite acute and opened after the monsoons from November to March.

A few voluntary agencies have also started taking an interest in plantations for fodder. The Maharashtra Dhangar Samaj Unnati Mandal in Kolhapur has been trying to involve local shepherds in planting subabul trees. If successful, this could be the first time that pastoralists who have usually been dependent on the natural fodder base have fodder trees themselves. One of the oldest independent institutions which has worked for fodder trees is the Bharatiya Agro-Industries Foundation at Uruli Kanchan.

The answer to the huge problem of fodder lies in an appropriate and integrated national land-use plan. So far most attention has been paid to the area under cultivation. But nearly 50 per cent of the land area is uncultivated and most is uncultivable. India has not yet evolved any policies or programmes for its upkeep and proper maintenance except stray, occasional and disconnected efforts. The hard fact is that the management of forest lands, grazing lands and croplands cannot be isolated from each other.



**Migratory Route of Livestock in Rajasthan**

The migrants usually follow the following routes:

1) In Bikaner, Jaisalmer and Ganganagar districts cattle migrate towards canal areas in Ganganagar and Ferozpur in Punjab.
2) Livestock from Nagaur, Jodhpur and Pali districts generally follow the route to Ujjain via Manliawas, Nasirabad, Bundi, Kota and Jhalawar. From Ujjain the herds move to Indore or Dhar on one side and to Rewa on the other.
3) Livestock from Kota district migrate along the Agra-Bombay route towards Girnar and Shivpuri and towards Ujjain and Indore in Madhya Pradesh.
4) Some herds take the route from Kota to Gwalior, Shivpuri and Jhansi
5) Cattle from Jalore district move through Sirohi, Palanpur and Banswara to Mahva
6) Some breeders also move with their herds to Dessa, Patanpur, Gujarat and towards the Rann of Kutch.

The above migratory movements are initiated in the month of November-December. The return migration occurs with the onset of monsoon during the month of June/July.

## SOIL EROSION AND RAVINES

Lahar is a village 25 km north of Morena. Its air was once heavy with the smell of moist soil, its evenings laced with the splintered, reedy songs of Allha and Udal, the braves of Prithviraj Chauhan. But now all life has fled. Heaps of stones, a yawning hole for a door, fissured walls and a dying well are all that remain, yet more victims of the advancing ravines. Surveying the desolation, V.K. Sharma, sub-divisional officer, Morena, comments: "There are hundreds of Lahars in this area." He points to another village in the distance: "In a few years that too will be devoured."

Ravine and gully erosion are possibly the most spectacular types of erosion and have already degraded about 40 lakh hectares in the country. The problem mainly affects the states of Uttar Pradesh, Madhya Pradesh, Bihar, Rajasthan and Gujarat, which account for over 33 lakh hectares of ravines found along the Chambal, Yamuna, Mahi, Sabarmati and their tributaries. These ravines are threatening to encroach upon another 50 lakh hectares to 60 lakh hectares of adjoining productive table lands.

In the districts of the famous Chambal valley more than 10 per cent of the villages have become completely depopulated. On the edges of the Chambal and its tributaries the ravines progress at a relentless crawl. A local saying is: "The earth moves even before the rains come." As the rains come the fissures grow wider and threaten to cave in. The villagers move towards the unaffected lands, bringing more pressure on the already crowded area. The ravine-affected villages are not depopulated in a sudden rush; the retreat is gradual. Displacement results in fragmentation of holdings, making cultivation highly inefficient and uneconomic.

### Steady process

How are ravines formed? When rain falls on soil unprotected by stable vegetation cover, the raindrops explode in a splash of muddy water. Soil particles flow down the slope with the moving sheets of water, causing 'sheet erosion'. Due to the uneven topography, run-off concentration occurs, giving rise to rills which develop into small gullies which then grow bigger and bigger into ravines.

Ravines refers to a deep gorge containing systems of running of gullies parallel to each other in deep alluvium and entering a nearby river flowing much lower than the surrounding table lands. The nature of the alluvial soil causes water run-off problems from table lands. Additionally the river cuts very deep channels in alluvial lands while negotiating a large fall in a short distance. Such a situation creates waterflow conditions conducive to the rapid

### Milking the Land

In late 1983, the prestigious Operation Flood programme came in for severe criticism in the press. Minister of State for Agriculture Yogendra Makwana sparked off a furore by telling parliament, that the government intended to evaluate the working of the National Dairy Development Board (NDDB), the body in charge of Operation Flood. Promptly, 700-0dd NDDB officers resigned. Soon after, the government ate its own words by telling parliament that Operation Flood was a grand success. The evaluation now will be confined to the working of phase II of Operation Flood.

The current animal husbandry debate centres on the nature of the government's animal husbandry programmes which since the 1970s have moved rapidly away from "animal husbandry" proper towards dairying, mainly to proudce milk for urban areas. At a time of acute fodder shortage, and given the vast majority of the rural population which needs animals for ploughing, the government has no major programmes to solve this problem.

The history of animal husbandry in India is illustrative of a major shift in priorities. In 1927, the Royal Commission on Agriculture (RCA) concluded that the primary function of cattle is to serve as draught animals. Milk production was thought to be a secondary consideration. The commission gave feeding priority over breeding. As significant additions to grazing areas were not possible, the need to raise the productivity of grasslands was stressed and the scope for such efforts considered great.

In 1958, agricultural expert M.S. Randhawa recommended cultivation of fodder crops in a crop rotation programme. FAO expert, R.O. Whyte studied mixed farming systems on small holdings. Regeneration of village pastures was technically possible, as natural grass could revive under protection. It was the social problem of overgrazing that had to be tackled by the gradual closure of certain sections of grazing for a number of years.

Thus, until 1960, as Rita Brara of the Institute of Development Studies, Jaipur points out animal husbandry was veiwed as linked to the problem of increasing the productivity of small holdings of land through crop rotation, nurturing better-fed, highly productive cattle, and improving grazing lands.

During the first three plans, the Key Village Scheme (KVS) stressed the setting up of bull breeding farms in major cattle tracts, and was gradually transformed into a more comprehensive programme for general cattle development, including improved nutrition. But an official review in 1961 said that the KVS projects contribution to improvement in genetic quality and productivity was insignificant.

This failure led to the Intensive Cattle Development Project (ICDP), whose primary purpose was to increase the production of milk to feed public sector dairy plants in the hinterlands of main urban centres. It placed great emphasis on crossbreeding indigenous cows with exotic European and American dairy breeds and tended to be concentrated in milkshed areas of large cities and towns.

The emphasis on milk production was further strengthened by Operation Flood 1 (OF I)—July 1970 to June 1977—and Operation Flood II (OF II), scheduled to be completed by the mid-eighties. With an investment of Rs 480 crore and spread over 160 districts, it is one of India's biggest dairy development projects. The main objective is: a self-reliant dairy industry of 10 million rural families and a national milch herd of about 14 million crossbred cows and she-buffaloes by middle 1980s; linking up rural supply sources and urban demand centres; and to increase per capita consumption of milk.

Thus, within a decade, the government shifted its policy towards cross-breeding of indigenous cattle with exotic stock for a spurt in milk production to feed the cities. One of the theories behind this new strategy is that even better feeding of indigenous cows would only increase milk-yield by 50 per cent, from roughly 350 litres per lactation to a still uneconomic and insufficient 525 litres. The purchase of expensive concentrates and the cultivation of green fodder do not become economically sound propositions until the cow yields about 1250 litres per lactation in village conditions.

The idea now is to eventually evolve a mix: of low-yielding animals providing draught power and milk which are fed on crop residues and natural herbage and small high-yielding national milch herd. The Green Revolution in pockets has created the expectation of crop rotation on scientific lines that would incorporate the production of green fodder.

But so far there is little evidence to show that crop rotation to accommodate green fodder production has been adopted by farmers. Even at Anand, the cropping pattern has not changed development of gullies along the river banks and thus form ravines.

Once a ravine is formed, waterfall erosion deepens it further, increasing the hazard of cave-ins along the sides and at the head. At high flood levels the river backs up into the ravines, adding to the process of saturation and slip of the sides. Prolonged inundation also damages the protective vegetation cover.

The formation of ravines must have started with increased human pressure on land. Cultivation came to be extended gradually to the marginal and sub-marginal lands, removing from their surface the essential vegetation cover. The reckless tilling of land, without resisting adequately the abrasive effect of water or arresting the washed-away soil must have continued for years together. Even the leftover vegetation of the ravinous patches must have been consumed in several ways, by grazing and firewood collection.

All this resulted in widespread devastation. In the districts of Bhind and Morena the ravine area has gone up by as much as 36 per cent in 30 years. Between 1943 and 1950 ravines in these two districts grew by 800 hectares per year: between 1950 and 1975 they grew by over 5,000 hectares per year due to large scale deforestation and denudation of vegetation cover. In these districts only 20.58 per cent of the area is under forest. The maximum cultivable area has been brought under the plough and hence there are shortages of forest products, particularly firewood.

Today, development work has added to the problem. Though the irrigation schemes launched by the Chambal Command Area Development Authority (CADA) have undoubtedly benefited the farmers they have had their adverse affects. These programmes have caused deforestation of the land earmarked for canals and consequently increased the demand for forest produce—timber, firewood, fodder and so on—further increasing pressure on forest resources.

### Spreading devastation

The country is losing almost 8,000 hectares to ravines every year. The rate of growth of ravines is estimated to be 0.5 per cent annually and at the rate land is being reclaimed it will require 150 years to complete the work, by which time the total ravine area will double. This means that the total watershed of the rivers will consist only of ravines and their table lands will be completely wiped out.

The problem of ravines is not just of erosion and development of land. From times immemorial the Chambal valley has been known for its dacoit gangs, for whom the ravines provide safe hideouts. The total locked up production potential in the bandit-infested ravine areas of Uttar

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and milk producers have preferred to buy feed rather than grow it. The high-yielding breeds require a proportionately larger amount of green fodder and concentrates and, firstly, they would take them from other, humbler breeds and, secondly, there would be a crunch on land if crossbreeding was introduced in a large way—concentration require four times the area needed to produce green fodder.

Added to this is the disturbing fact that the current green fodder output from irrigated land is pitiful and that the area under fodder crops has remained more or less the same in the last few decades. As the National Commission on Agriculture pointed out: "This is the rather disturbing trend paticularly in view of the fact that a number of important projects have been launched for development of animal husbandry."

**Feeds and fodder availability, 1973**

| | Concentrates | Dry fodder | Green fodder |
|---|---|---|---|
| Availability | 11.0 | 309.0 | 214.0 |
| Requirements | 19.5 | 347.4 | 343.4 |
| Shortage (%) | 44.0 | 11.0 | 38.4 |

Source: Report of the National Commission on Agriculture, 1976.

However, one argument often used is that the landless would benefit from a dairy development programme. Households which have no land or less than 2.50 acres of land, consituting 60.28 per cent of the rural households, account for 9.25 per cent of the operated land and 28.73 per cent of the milch animals. Agriculture ministry official P.S. Appu, thus, argued that milch animals are more equally distributed than land and that dairy development based on the Anand pattern can be exploited in an anti-poverty programme.

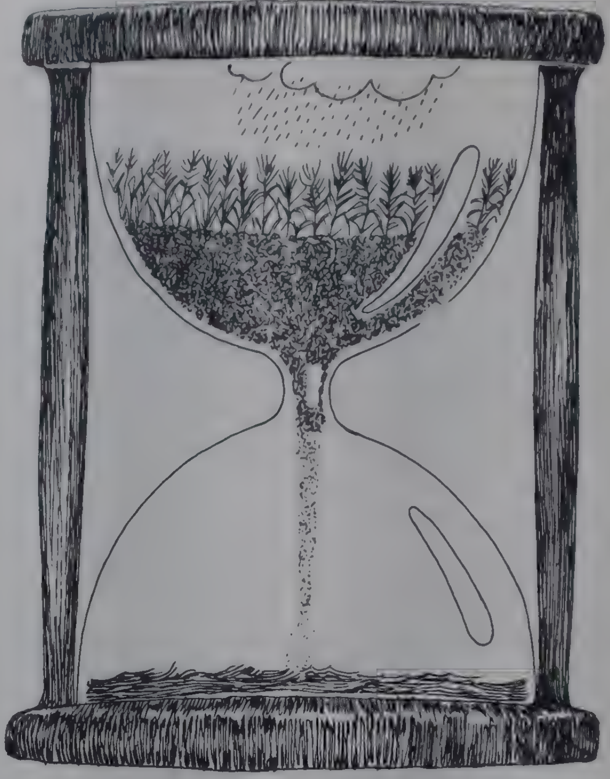
Others argue that their very poverty would ensure that the benefits would not come to them. Economist K.N. Nair claims: "Given the unequal distribution of milch animal holdings, the benefits of dairy development are unlikely, in the normal course, to benefit the poorest classes. The fact that the relatively weaker sections do not have the resources needed to maintain high quality milch animals makes it all the more likely that dairy development programmes based on crossbreeding, milk marketing, processing and distribution would hardly benefit them; instead the benefits would accrue to the better off segments."

Operation Flood has aimed only at raising milk production and not at improving draught breeds. K.N. Nair and M.G. Jackson have proposed a strategy which includes: better feeding of calves rather than starving them in favour of milking animals; rehabilitation of village common lands, through subabul plantation for instance, to increase green fodder production on such lands from 3 tonnes per hectare per year in the rainy season to 20 tonnes to 30 tonnes throughout the year; and setting up village cooperatives to manage them.

If village common lands and other public lands could be afforested with fodder species, even the poor could benefit from dairy programmes. In the tribal belt in Gujarat extending from Rajpipla to Nagar Haveli, the denudation of forest lands is forcing tribals to non-traditional occupations like animal husbandry. In a study of milk cooperatives in the region, Professor J.M. Heredero of the St Xaviers'College, Ahmedabad noted that the their impact on tribals has been extremely limited. The non-availability of fodder is "of critical importance in the case of landless and poor farmers", says Heredero." Lack of balanced nutrition is an important factor leading to high buffalo mortality, low pregnancy rates and subsequent low rate in the in-milk buffaloes and low milk yields." The problem of fodder is acute since 48 per cent of the primary producers surveyed are landless. But the problem is keenly felt among the landowners as well, says Heredero, strongly recommending community action for growing green fodder on village pasture land.

Unfortunately, institutions like cooperatives have been the major stumbling blocks in most plans for animal husbandry, argues Brara. They have succeeded as marketing societies but failed at management of common resources because of clashes of interest. But the fundamental imbalance has to be corrected as there is no alternative. There is need for greater emphasis on animal husbandry not milk production masquerading in the name of animal husbandry, employment is to be secured for those who rely primarily on rearing cattle for a means of livelihood. The management of common lands for developing grazing resources, thus, remains the key issue. Unfortunately, government programmes have shied away from this crucial question, which involves all the thorny political problems of land ownership and management.

Pradesh, Madhya Pradesh and Rajasthan is 3 million tonnes of foodgrains annually besides fruit, timber, fodder and other raw materials. On a conservative estimate the country is losing an annual Rs 157 crore by its failure to reclaim and develop ravines. Here more than economic compulsions are at work: ravines classified as 'deep ravines' are a total writeoff for they cannot be reclaimed for agricultural purposes. More delay would lead to more deep ravines. Hence the need to start reclamation on a war footing.



In the erstwhile Gwalior state the government set up a commission to study the situation. The commission recommended afforestation and soil conservation works.

Old settlement (1939) reports of Morena show that since the previous settlement of 1912 the area under ravines had doubled and by 1943 it covered 21 per cent of the tehsil area. Ravines covered 49 per cent more area in the 1915 settlement of Bhind as compared to the previous settlement of 1898. Some of the increase may be attributed to better classification in succeeding settlements.

Following the commission's recommendations 1,200 protective bunds were set up and 4,000 acres of ravines reclaimed in Bhind and Morena. A department of behad (ravines) was also set up but the scheme did not make much headway for lack of personnel and funds. In 1945, an American soil conservator was invited by the Indian government and he suggested control on grazing and contour bunding as solutions. After the merger of Gwalior with Madhya Bharat another team of experts suggested similar remedies: only low basins of ravines sufficiently wide to form large plots be reclaimed; existing gullies be used to divert rain water for the protection of the reclaimed areas; top cultivated lands be protected against further encroachment by the ravines; and lower reclaimed basins be given adequate protection against soil erosion.

The government of Madhya Bharat sanctioned a proposal for the survey and reclamation of the ravines in 1954. Work began in 1954–55 and a coordinated programme of contour bunding and reclamation of shallow ravines was executed at Chhonda near Morena. In its wake several such projects were started in other centres of the state. The Indian government appointed a team under the auspices of the Central Water and Power Commission to further study the question of ravine reclamation. An extensive survey was carried out in the Chambal area, the last serious survey of ravines in Madhya Pradesh. Later figures are mostly approximates and it was concluded that the reclamation would be economical if the cost per acre did not exceed Rs 1,250.

**Extent of ravines in the Chambal valley and number of villages deserted during this century**

| District | Ravines (Hectares) | Ravines as % of total land | Villages | Depopulated villages |
|---|---|---|---|---|
| Bhind | 119,000 | 26 | 956 | 57 |
| Morena | 192,000 | 16 | 1429 | 172 |
| Gwalior | 108,000 | 20 | 855 | 90 |
| Jalaun | 79,000 | 17 | 1155 | 201 |
| Etawah | 93,000 | 21 | 1533 | 83 |
| Agra | 106,000 | 22 | 1230 | 53 |

A classification of ravines was done and measures were formulated for application in similar projects elsewhere. The basic approach was: bunding and use of agronomical practices on the top lands; establishment of green belts on the submarginal lands; conversion of steep slopes at gully heads into gentle slopes and their stabilisation; and reclamation of ravine lands by constructing soil-saving dams to facilitate the arresting of silt and development of silted basins.

Despite the reams of suggestions, the pace of reclamation has been a crawl. In 25 years 18 projects have reclaimed a measly 3,137 hectares of ravine land, a negligible achievement given the growth of ravine land during the same period.

**Massive plan**

Apart from the central sector schemes begun in 1971, the Centre's main contribution was the preparation of a massive ravine reclamation plan by a working group set up by the Home Ministry in 1971. It drew up a Rs 1,224 crore programme spread over 27 years. There were four segments of seven years each. The first segment was to produce 55,000 hectares of new land for agriculture, 27,500 hectares of horticultural plantations and 27,500 hectares of afforestation and grassland development in Uttar Pradesh, Madhya Pradesh and Rajasthan; 220,000 hectares of table land area was to be 'bunded' and waterway diversion ditches and ravine head control structures built.

The first segment would cost Rs 283.62 crore and create employment for 3,273 engineers, 11,376 skilled workers and over 240,000 unskilled workers. It offered a return of 11 per cent on investment. But it was not to be. In 1972 over 500 dacoits surrendered in Madhya Pradesh and some bureaucrat or bureaucrats may have decided there was no more need to reclaim the ravines. The plan was shelved.

In1977-78 a project for ravine reclamation and stabilisation and protection of table lands was submitted to the Centre by the state government. One lakh hectares of catchment area were to be treated in Bhind, Morena, Gwalior, Datia and Chhatarpur. This plan, too, went astray in the bureaucratic ravines of New Delhi. Reclamation work received a further setback in 1979 when the Madhya Pradesh government decided to suspend reclamation schemes since the Centrally-sponsored schemes had already been stopped and the reclamation cost per acre had become too high.

According to V. Nigam, former chairman of CADA, the usual economic concepts should not be applied to ravine reclamation. The cost would be justified by the long-term social benefits. The earlier schemes had failed because being too small, there was no economy of scale. Also they re scattered and the staff lacked a project approach. The sult was that there was no cost consciousness and most of e schemes were delayed. Further, the reclaimed area was t under stringent terms of auction which the poor farmers uld not meet. The factor which held back private efforts is the ridiculously low subsidy rate for ravine reclamation. hile farmers could get up to Rs 3,000 and 50 per cent of the st for tubewells, the subsidy for reclamation was only Rs 0 per acre.

The Madhya Pradesh forest department established a parate soil conservation division in 1966-67 which tackled pout 12,000 hectares by 1975. However, these areas being venue wastelands, could not be given adequate otection against grazing and browsing as the provisions of e Indian Forest Act could not be applied.

In 1980 a phased programme for afforestation by aerial eeding was drawn up under which 12,000 hectares were to e taken up annually. Aerial seeding was done in 1980 but ne target could not be achieved; it is too early to say how ne scheme has worked.

Forestry was not included in the CADA projects but its nportance could not be ignored. The project proposed to stablish 11,000 hectares of plantations in the peripheral avine lands of the Chambal command area. In the first hase CADA constructed, along a perimeter of about 115 km, mall grass seeded earth embankments and parallel drainage channels to route the drainage run-off safely through the ravines to the various river courses. In the first phase nearly 23,000 hectares of farm land have been protected from the ravines. In the second phase another 150 km of such perimeter works are to be undertaken in areas where the measured rates of erosion are high. An estimated 25,000 hectares will benefit.

**Area under ravines in the country** (lakh ha)

| State | Area | | |
|---|---|---|---|
| Uttar Pradesh | 12.30 | Punjab | 1.20 |
| Madhya Pradesh | 6.83 | Bihar | 6.00 |
| Rajasthan | 4.52 | Tamil Nadu | 0.60 |
| Gujarat | 4.00 | West Bengal | 1.04 |
| Maharashtra | 0.20 | | |

Meanwhile, the ravines continue their inexorable advance towards the table lands. The government is to be blamed for inaction and a disturbing lack of vision in understanding the gravity of the situation. Recently a Rs 2,000 crore plan was announced for the development of the Chambal valley but whether it has been announced with an eye to the elections is yet to become clear. But the evidence of the past does not hold much hope for the future.

## The Wastelands

What is the extent of wasteland in India? The estimate of the Delhi-based Society for Promotion of Wastelands Development (SPWD), comes to well over 100 million hectares: as much as one-third of India's land area is suffering from serious environmental problems.

The SPWD estimated wastelands only in non-forest areas as there is a lack of relevant data relating to degraded forest areas. The area affected by salinity and alkalinity is about 7.17 million hectares, basically covered under the category "barren and unculturable land" in the country's land-use statistics. As for the area affected by wind erosion—by shifting sand dunes, coastal sand dunes and extreme moisture stress—the study assumes that this problem is limited to the 11 western districts of Rajasthan and three districts each of Gujarat and Haryana, and the total wind-eroded area works out to 12.93 million hectares. This figures does not include coastal land affected by sand dunes because of lack of data, and may fall short by one to 2 million hectares. The total water-eroded area in the country—land affected by sheet erosion, ravines, waterlogging, riverine lands, gully erosion, shifting cultivation, etc—comes to 73.6 million hectares, and the total non-forest land seriously affected comes to 93.69 million hectares. The total cultivated area suffering from erosion works out to 41.5 million hectares as compared to the 70 million hectares estimated by the National Commission on Agriculture in 1976.

H. Null/FAO

To SPWD'S estimate of degraded non-forest land ought to be added the area of degraded forests lands. The Forest Research Institute argues that degraded forest area is limited to the 17.6 million hectares of unclassed forests. The Department of Environment claims that less than half of the 75 million hectares classed as forest lands is actually under adequate tree cover. Thus estimates of degraded forest lands vary from 17.6 million hectares to 37.5 million hectares, and the total extent of wastelands ranges from at least 111 million hectares to 131 million hectares.

A recent study on land-use in Gujarat conducted by the Operations Research Group shows how serious soil erosion problems are becoming. The area under cultivable wastes went up from 0.76 million hectares (4.21 per cent of the reporting area) to 2 million hectares (10.65 per cent of the reporting area). In the rest of the country, the area under cultivable wastes actually declined in this period as more marginal lands came under cultivation. It is possible that some barren and unculturable land has also come under this classification in later years.

But what is interesting is that detailed surveys in representative taluks show that the poverty of smallholders, erosion of soil, and waterlogging due to improper soil and management practices in irrigated tracts are the three main reasons for the land remaining uncultivated. Of the land under current fallows in 1976-77, 33 per cent was in this condition specifically because of soil erosion.

This was a particularly important reason in the Kutch region, eastern border hills and the semi-arid plains. In 1960-61 there was more land under current fallows in Gujarat but less than 5 per cent of the land was then in this condition because of soil erosion problems. The soil erosion problem has dramatically increased for Gujarat farmers in less than two decades.

# MINING

Mine areas often have a monochromatic appearance. Coal mining areas are depressingly black, iron ore towns are red, ochre lends a yellow colour and limestone makes everything chalky white. Fine particles of ore spread as a uniform layer of dust on every available surface in these areas.

The pervasiveness of dust is the strongest indication that mining is not a benign activity. Unless it is carefully planned and thoughtfully carried out, it can lay barren the land, pollute water, denude forests, defile the air and degrade the quality of life for people who live and work in the vicinity. Modern technology has enormously magnified our ability to extract minerals. In the process, it has also gravely threatened human lives and the environment.

## India's mineral production

Since independence, India has witnessed a phenomenal growth in mineral production from Rs 700 million worth in 1950 to over Rs 34,000 million worth in 1981. Fossil fuels constitute the bulk of the mining output in India. Coal production exceeds that of all other fuels and minerals. Iron ore and limestone predominate among metallic and non-metallic minerals respectively.

India is poorly endowed with mineral wealth. Except for iron ore and bauxite, our share of the world's reserves of every other mineral is one per cent or less. According to sixth plan estimates, if the present production trends continue, we will exhaust our reserves of all the important minerals and fuels except coal, iron ore, limestone and bauxite, very early in the next century.

Within the country, the geographical distribution of fossil fuels and metallic minerals reserves is highly uneven. Only the non-metallic ores show an even geographical spread. About 40 contiguous districts in central and eastern India account for more than half of all the national mining output. The most important mineral reserves are located in these districts. As production continues to expand, these districts are doomed to become wastelands unless serious conservation and reclamation measures are undertaken now.

**Production trends of selected minerals ( Million tonnes )**

| | Fossil Fuels | | Metallic Minerals | | | Non-Metallic Minerals | |
|---|---|---|---|---|---|---|---|
| | Coal | Petroleum Crude | Iron Ore | Copper Ore | Bauxite | Manganese | Limestone |
| 1950 | 32.8 | — | 3.0 | 0.366 | 0.065 | 0.9 | 2.3 |
| 1960 | 52.6 | 0.5 | 16.6 | 0.448 | 0.387 | 1.5 | 12.9 |
| 1970 | 73.7 | 6.8 | 31.4 | 0.518 | 1.374 | 1.7 | 23.8 |
| 1980 | 109.1 | 9.4 | 40.9 | 2.005 | 1.778 | 1.7 | 29.2 |

## Mining processes

The nature of the environmental impact of mining depends upon the process of mineral extraction. On land, there are two basic methods of mining: open cast and underground mining.

### Open cast mining

The topsoil, earth, rock and other strata, called overburden, are completely removed to provide access to the ore seam. The mineral seam is drilled and blasted with explosives to loosen and break it into boulders and rocks. The rocks are then removed, leaving the mine face clear for further drilling and blasting. The ore is transported away from the mines for cleaning, sorting, concentration and extraction. Sometimes, the first step of the cleaning process may take place at a site adjacent to the mine. Open cast mining can yield 80 per cent to 90 per cent ore recovery.

**Reserves and production of major minerals in central eastern India mining belt — the major tribal belt of India**

| Mineral | Quantity Produced | | Geological Reserves | |
|---|---|---|---|---|
| | Million Tonnes | % of National Production | Million Tonnes | % of National Reserves |
| Coal | 119.6 | 97.6 | 82,772 | 98.9 |
| Iron ore | 23.5 | 57.2 | 8,278 | 64.98 |
| Copper | 1.226 | 58.8 | 279 | 69.7 |
| Bauxite | 1.052 | 55. | 1,956 | 89.35 |
| Manganese | 0.757 | 50.1 | 52.9 | 66.5 |
| Chromite | 0.279 | 83.5 | 15.9 | 91.9 |
| Limestone | 16.6 | 53.6 | 24,726 | 39.15 |

Source: Centre for Monitoring Indian Economy, Bombay, Sept. 1982

### Underground mining

The mineral is directly mined by creating access to it through a horizontal, inclined or vertical tunnel. As the ore is removed to the surface, the passages that are tunnelled underground have to be provided with roof supports to prevent it from collapsing. Thus, large blocks of the mineral have to be left undisturbed to act as pillars to support the roof, and it is possible to recover only 50 per cent to 60 per cent of the ore. It is loosened by drilling and blasting and is then brought to the surface for dispatch or further processing.

In India, mining activity ranges from the small, completely manual stone quarries to cavernous mechanised mines. With increasing mechanisation, mining equipment has grown larger and more powerful. The use of power shovels, hydraulic excavators, massive dump trucks, with capacities up to 170 tonnes, and conveyors can move tens of thousands of tonnes of material in the day. Entire landscapes are altered in a relatively short period of time.

## Adverse environmental effects

Mining ruins the land, water, forests and air. The loss or pollution of natural resources degrades the quality of human life in these areas. Increasingly, mineral-based production units like coal-fired power plants, steel plants and cement factories are located near the mines. A cluster of eight thermal power stations are planned near the Singrauli coal mines, because it is cheaper and easier to transport electricity than to transport coal. All the major steel plants, including the proposed plant at Visakhapatnam, are concentrated in the Bhilai-Bokaro-Rourkela-Jamshedpur-Durgapur-Burnpur-region. Add to these aluminium extraction plants, copper complexes, cement factories, engineering units, rail and road networks, sidings and stockyards and the environmental onslaught of this mining-manufacturing complex multiplies murderously.

### Loss of agricultural lands

A precise estimate of the amount of agricultural land lost to ining is not readily available. The total amount of land rectly given to mining can be computed from the irectory of Mine Leases published by the Indian Bureau of lines (IBM) in Nagpur and adds up to a few million hectares.

Every mining enterprise, however, means the con-ersion of land to such purposes as roads, railways and opeways for mineral transport, townships for housing niners and managers, infrastructure for administrative urposes, land for stockyard and for preliminary processing perations. In effect, the total land affected by mining is nany times larger than the simple lease area.

The first stage of surface mining involves the removal of egetation and topsoil. Since the mined areas are usually bandoned without the adoption of any reclamation neasures, they become barren.

The disposal of mining debris requires additional area nd renders the surrounding land infertile. "On an average tonnes of reject material is required to be removed for every tonne of saleable (iron) ore," says a report on an eco-development plan for Goa prepared for the Planning Commission. Rainwater washes out material from the waste dumps to the adjoining agricultural fields and streams. The residues often harden on drying, making the fields uncultivable. In regions where people practice subsistence farming, particularly in hilly and desert areas, this leads to pauperisation of marginal farmers.

Underground mining can lead to subsidence of land. The roof of an underground mine is supported by timber and pillars of the ore. When an underground mine is abandoned, mine operators try to extract as much ore as possible. Excessive depillaring and removal of timber leads to subsidence, marking the mined area with big crater-like depressions.

Vast tracts in the coal mining districts of the mining heartland, threatened by subsidence, have been rendered unsafe for habitation, agriculture and grazing. They have

## Nutrient Drain

Is the green revolution killing the goose that lays the golden egg? Is it draining the very soil where the high-yielding varieties are planted? It would seem so. Scientists are discovering to their dismay that intensive cropping is removing the crucial micronutrient elements—zinc, iron, copper, manganese, magnesium, molybdenum, boron—which form only one per cent of the weight of a plant but control various aspects of a plant's processes. Zinc helps the plant use nitrogen and phosphorus, iron is responsible for the synthesis and maintenance of chlorophyll and so on. For instance, Ludhiana district of Punjab records the highest yields of many crop but it also records the most alarming deficiency of micronutrients.

Apart from using major fertilisers like nitrogen, potassium and phosphorus (N, P and K), many farmers in Punjab are using zinc as fertiliser to cope with the growing depletion of zinc and reduced yields. The sales of the leading Indian company manufacturing micronutrients have jumped from Rs one crore in 1975 to Rs 6 crore in 1982 and the company hoped to touch the Rs 10 crore mark in 1983. Presently less than one per cent of India's cultivated land is treated with micronutrients but the area is certain to grow. Several small manufacturers of plant micronutrients are coming up around the bustling cities of western India like Pune.

Every crop removes both micronutrients and macronutrients from the soil. But farmers tend to put back only N, P and K. In fact, most farmers add only nitrogen, as other fertilisers are too expensive. A study at the Ranchi Agricultural College in 1975–76 reported that the use of 100 kg/hectare of NPK (in the ratio of 50:25:25) led to depletion of zinc by 629 gm per hectare and copper by 433 gm per hectare.

Trying to restore the deficiency of one micronutrient by adding it in a chemically pure form can lead to another micronutrient deficiency. In Kanganwal village of Ludhiana district, where farmers use zinc as fertiliser, zinc deficiency has been replaced by iron and manganese deficiency. In another five villages, copper deficiency has taken over. One study of wheat crop in Ludhiana shows that next to zinc, deficiencies of copper and manganese are likely to arrest crop yields.

Zinc deficiency is the most widespread of all micronutrient deficiencies. Over half of 8706 soil samples from Punjab were found to be lacking in zinc. Its deficiency can depress yields by 0.16 to 3.9 tonnes per hectare of rice, 0.01 to 1.98 tonnes per hectare of wheat and 0.06 to 3.4 tonnes per hectare of maize. The results of about 3,000 field experiments in different states show average responses of cereals, millet, pulses and oilseed crops ranging from 1.0 to 6.7 quintals per hectare to varying levels of zinc. Another 14,000 field experiments conducted from 1967 to 1977 have shown striking increases in the yields of wheat, maize, rice and millet with zinc application in 75 out of 82 districts. Significant increases in grain yields of crops were observed in more than half of the experiments.

Next to zinc, iron deficiency is the most serious impediment to production. It has been reported from Punjab, Haryana, Andhra Pradesh, Uttar Pradesh, Bihar, Gujarat and Tamil Nadu, and is emerging as a limiting factor in rice production in the new rice-wheat rotation that has been evolved in the non-traditional rice growing areas of Punjab. Iron deficiency has also been observed in groundnut, sugarcane, perennial multicut fodders, peaches and ornamental plants in many areas in Punjab. It is prevalent in 52 per cent of the samples of arid brown soils.

One solution being advocated by soil scientists worldwide is to recharge the soil by continuously adding the deficient nutrients in chemical form, such as nitrogen. But not every farmer can afford micronutrients and the application of zinc, for instance, has to be carefully done to avoid a toxic build-up. As much as 80–90 per cent of the applied zinc gets converted to forms which are not available to the plant.

Easier solutions lead back to traditional farming systems and increased use of organic manures and multiple cropping with legumes. According to a Punjab Agricultural University experiment in India, poultry manure, farmyard manure and piggery manure were found effective for meeting zinc requirements of a maize-wheat rotation. Similarly, some leguminous crops like cluster bean and green manure put the nutrients back into the soil. There are other cultural practices such as prolonged submergence of the field which can be used for tackling iron and manganese deficiency. Unfortunately little attention is paid to such methods.

Micronutrient deficiency affects the quality of food and, in turn, human and animal health. Consumption of zinc deficient foodgrains by human beings can lead to retarded growth and sexual development, defective wound healing and carbohydrate intolerance, according to research done by the Post Graduate Institute of Medical Sciences in Chandigarh. Zinc values were found to be low in diabetic and diabetic ulcer patients. Livestock, too, suffer. Most forage samples from the two Green Revolution states of India have been found to contain less than 20 parts per million of zinc, which can lead to a disease called parakeratosis or retarded growth, bone and joint disorders in cattle grazing on such fodder.

Studies conducted in Punjab reveal that the quality of wheat, maize, and rice improve after zinc application, which leads to an appreciable increase in energy values, crude protein and carbohydrates.

In a country with extensive malnutrition neither can we allow crop yields to go down, nor can we allow our agricultural base to be undermined. The problem of micronutrient dificiency will have to the resolved.

It is however not too late to act.

## Desertification

A United Nations document defines desertification as "the diminution or destruction of the biological potential of the land which can ultimately lead to desert-like conditions." In arid and semi-arid regions, where restoration of the fragile ecosystem is very slow, mining adds significantly to other desertification pressures. Studies done at CAZRI in Jodhpur show that it takes three to five years to establish grass cover in arid areas.

The arid lands of Rajasthan account for most of India's production of lead, zinc and tungsten concentrates, asbestos, phosphorite, gypsum and steatite. Other major minerals are, copper ore, kaolin and limestone. Between 1970 and 1976 there was an 86 per cent increase in area under mining leases, for almost 50 different minerals.

"The existing mining regulations have taken into account only the systematic and complete exploration of mineral deposits without any consideration of the after effects of the mining operations on land productivity," charge Dr H.D. Mann, director of CAZRI and his colleague Dr P.C. Chatterji. Removal of vegetation and disposal of mining rejects in the arid areas of Rajasthan increases their susceptibility to erosion, they add. Desertification processes originate from such areas.

Development of soil salinity due to mining has degraded land around quarries in Jodhpur, Udaipur and Jaipur districts and near the gypsum quarries in Barmer district. Mineral beneficiation and processing in the vicinity of the mines completes the denudation of vegetation. Mann and Chatterji have reported the total destruction of various species of trees and natural vegetation around the zinc smelter near Debari and similar phenomena near cement factories, soapstone and phosphate rock crushing facilities.

been officially declared as derelict lands and are now permanently unfit for productive purposes. "The Jhagraha Colliery is an abandoned mine near Amlai. Hundreds of acres of land above the mined area have collapsed and signboards all around the periphery warn visitors that it is a danger zone," reveal the authors of 'Planning the Environment', a report on Shahdol district in Madhya Pradesh. Since most of the working coal mines are underground ones, several lakh hectares of land in eastern India may be permanently lost unless proper techniques of depillaring and timber removal are adopted.

Damage to land can also result from underground and stockyard fires in coal mining areas. Coal is normally accompanied by methane gas which is released when the coal is fractured and crushed during production. This gas can ignite spontaneously and it is extremely difficult to stop an underground coal seam from burning once it ignites. The normal practice is to seal off the tunnels where the fire has started so that it is starved of oxygen. This process may take years. In the Jharia coalfields, an underground fire has raged for 56 years, covering 1832 hectares, and has reportedly consumed 37 million tonnes of coking coal.

### Deforestation

Much of the mining activity in India is being carried out in forested regions. The obvious result is deforestation and erosion. Underground mining also significantly denudes forests because timber is used for supporting the roofs of mine galleries. In Goa, mining leases are spread over 43 per cent of the forest area. "Because the mining leases do not bind the mine owners to undertake any soil conservation measures or refill the worked-over mines, a large number of abandoned mines are lying in bad shape and are under extensive gully erosion," said S.S. Chana, conservator of forests for Goa, Daman and Diu, in 1981.

Some of the most intensely mined areas in the central-eastern India mining heartland lie in an ecologically sensitive region. In this region the Chota Nagpur plateau and the Maikal Range feed five major rivers: the Narmada, Sone, Rihand, Mahanadi and Damodar. At Amarkantak, the highest point in the Maikal Range, and the source of the Narmada river, the Bharat Aluminium Company (BALCO) and the Hindustan Aluminium Company (HINDALCO) operate bauxite mines. Here one can see bald brown hills standing in stark contrast against the lush green covers of sal forests on the slopes of the unmined hills. Though BALCO has a fledgling reforestation effort, the HINDALCO management chooses to be ecologically blind. Similar problems exist in the oil-bearing eastern Himalayan foothills, the catchment area of the Brahmaputra river, and the limestone-laden central Himalayan foothills feeding the Ganga-Yamuna river systems.

No frontier appears to be sacred anymore. In Bastar, the National Mineral Development Corporation (NMDC), a government undertaking is bent upon obtaining a lease to mine dolomite in an area that extends over 800 hectares of Kanger Reserved Forest. Mining will threaten the Kanger Forest Sanctuary, located near the lease area, where all commercial activity was banned almost 30 years ago to protect its delicate ecosystem. Private sector iron ore exporters are gouging out the forests of Goa, threatening its tourism industry.

Slate quarrying leaves giant grey gashes in the hills near Dharamsala in Himachal Pradesh. Some lush green hills have been reduced to massive heaps of grey rubble. A handful of limestone quarry owners have destroyed the verdant beauty of the Mussoorie hills (see box).

### Water

Mining wastes pollute streams and rivers. Ore fines and toxic substances, carried by rainwater into nearby watercourses, alters their chemistry and often makes the

**Extensive forests and paddy lands were destroyed to create this massive 1 km x 2.5 km copper mine at Malanjkhand. (Smitu Kothari)**

## Doon Doom

The Doon Valley is an exquisite region. Bounded by the Himalayan and Shivalik ranges and the Ganga and Yamuna rivers, its perennial water streams and fertile soils yield a mix of unique crops like tea, basmati rice and leechis. Mussoorie is a favourite of tourists and Dehra Dun is the home of many educational and research institutions.

Today, the valley is in danger because of uncontrolled quarrying for limestone. Mussoorie, often called the queen of hill-stations, is being stripped bare of its verdant cover. In the valley, the area under tree cover is now reported to be only 12 per cent as against the officially recommended 60 per cent.

"The main negative impact of quarrying is on the water resources and the scenic attraction of the Mussoorie hills", concludes the report of a study team led by Professor J.Bandopadhyay of the Indian Institute of Management, Bangalore. According to the report, commissioned by the Department of Environment and also submitted as an affidavit to the Supreme Court, mine debris is allowed to fall freely into river and canal beds, disrupting drinking water and irrigation supplies. In the Baldi river catchment area foodgrain production fell by 28 per cent in the last two decades and the water sources of 18 villages in the same area decreased by 50 per cent.

Further the limestone belt acts as a mechanism for capturing, retaining and releasing water perennially. All the important streams and rivers, such as the Song, Baldi, Rispana, Kairuli, Bhitarli originate from the same area as the limestone deposits. It is this capacity to store water that makes the limestone belt literally the life nerve of the entire Doon Valley.

Limestone quarrying has also led to the loss of grazing lands leading to a drop in cattle population. In the Baldi catchment, livestock population went down by 35 per cent but rose by 15 per cent in the Kalapatthar area—unaffected by limestone quarrying. The resulting loss of manure has affected productivity of wheat by 40 per cent and of rice by 33 per cent in the Baldi valley over two decades. Quarrying has destroyed entire villages and forced people into mining labour, brewing of illicit liquor or timber smuggling.

The Doon Valley quarries provide about 3 per cent of national limestone production. At present rates of consumption, the desposits will be exhausted in 50 years. The limestone is unique because of its very high purity and low silica content. Though client industries include 54 sugar mills, two cement factories and two paper mills, it is an invaluable raw material only for a special steel manufactured at the Tata Iron and Steel Company (TISCO). When its suppliers leases were not renewed in 1982, TISCO directors, who pride themselves on their environmental awareness, rushed to the Prime Minister.

In 1981, there were about 100 leases covering 1,400 hectares. Mines spread over 600 hectares are owned by a state-run corporation while most of the remaining belong to a handful of families, who have wreaked havoc with the connivance of corrupt officials and political leaders. When, in February 1983, the Uttar Pradesh government decided not to renew 18 leases that had expired at the end of 1982, the lessees immediately obtained stay orders. Quarry owners stampeded into increasing the pace of their mining operations.

To fight the vested interests, various citizen organisation's 'Rural Litigation and Entitlement Kendra', the 'Friends of the Doon Society' and 'Save Mussoorie Society' have filed a writ petition in the Supreme Court.

A report submitted by an expert committee appointed by the court revealed total disregard of mining regulations. "If the existence of even some violations of statutory provisions were considered adequate to call for the closure of the mines, almost all these mines become liable for the closure," it said. On the basis of the report of the courts' technical committee, headed by the controller of the Indian Bureau of Mines, the Supreme Court passed an interim order. The order declared the closure of the mines in category 'A' or those classified as extremely dangerous. The court also ordered a total ban on the use of chemical explosives for extracting limestone. A final decision from the court is now awaited.

The state government demonstrates a breathtaking callousness. Although Dehra Dun district is the second-most industrialised in the state, the government declared it "industrially backward" in early 1982, against the technical advice of the Town and Country Planning Organisation. This opened the way to new industries and of the 26 major ones proposed, half are limestone based. Pollution from the first of these units, the ARC cement plant in Gunialgaon and the 210 existing crushers and kilns has boosted dust counts to 350 microgrammes per cubic metre ($\mu$g/cum) as against the legal maximum of 100 $\mu$g/cum. The neighbouring sal forests and the health of residents thus face a new threat. The new industries will also impose severe strains on the region's water and power resources.

The Doon limestone is not an essential raw material for any of the user industries, except perhaps TISCO, and in that case too, alternate supplies may be available elsewhere. The Bandopadhyay report points out that the Doon Valley is ideal for non-polluting and service industries. However, the officials and politicians will have to be kicked into adopting such sensible advice.

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water unfit for human use. By locating mineral treatment facilities near the mines, water pollution problems get worse. These units use enormous quantities of water for washing the ore. The untreated effluents, slimes or tailings are often released into neighbouring streams or lakes. In many cases, the latter are the sources of water supply to the population. Washings from waste heaps and slimes from beneficiation plants can also cause silting of waterways, and flooding in regions of heavy rainfall.

The NMDC operates iron ore mines at Bailadilla in Bastar. The daily production is about 15,000 tonnes. Most of it is exported to Japan. The mining operations consume a tonne of water for each tonne of ore produced. The water is obtained by damming the Kirindul nullah. Effluents containing 18 per cent to 20 per cent of the mined ore, from the ore-screening plant at Deposit 14, are dumped into the nullah, turning it into thick red slime. This turbid stream joins the Sankhini river just downstream from the plant, turning its water red. Pollution of the Sankhini river affects 51 neighbouring villages with a population of almost 40,000 persons. The villagers, mostly tribals, have no clean water to drink, wash clothes or bathe. Their cattle also suffer. "All we have got from this project is lal pani," one villager told a visiting journalist. The tribals have renamed the Sankhini the "river of sorrow".

The NMDC has compounded its original sin of not including a tailings dam in the proposal for Deposit 14. Fourteen years after the problem first arose, "the NMDC and the state government continue to play ball, each accusing the other of ineptitude and inaction", writes Ayesha Kagal in 'The Times of India'. Meanwhile, the patience of the villagers and their faith in the authorities have faded. They are refusing to turn over their land for the construction of a tailings dam now, especially at the prices offered.

Continuous dewatering by underground mines also affects water resources. These mines annually pump out millions of litres to drain mine galleries and release it into nearby watercourses. This causes flooding, silting, waterlogging and pollution. They also lower the surrounding water table, reducing the available groundwater and the natural vegetation. The underground coal mines at Birsinghpur in Shahdol district pump nearly 3,000 litres of water per minute into the Ganjra nullah that runs into the Johilla river. As a result, the water table in the surrounding areas has dropped and large tracts are now devoid of vegetation.

The villagers around the Neyveli lignite mines have protested that they have been seriously affected by the mines. "In these villages the water level in the wells has been going down year after year due to the mines . . . . this year, both paddy and groundnut (crops) are failures," reported 'The Hindu', in May 1983.

### Air pollution

Mineral dust is a pervasive feature of all mining areas. It is generated by wind sweeping dust from waste heaps, blasting and the use of heavy machinery. Blasting also produces noxious fumes that are released into the atmosphere. Air pollution in mining areas causes respiratory diseases and eye ailments. Pneumoconiosis is a generic term applied to the group of lung diseases caused by inhalation of dust, including silicosis and asbestosis. The common eye diseases are cataract, conjunctivitis, corneal ulcers, glaucoma and squint trachoma.

The incidence of respiratory and opthalmic illnesses is more acute in the case of mining workers, whose workplaces are choked with dust. But they are also a significant problem for people who live near mines, particularly those whose health is already weakened by other illnesses.

The Roro asbestos mines at Chaibasa in Singhbhum district are the largest asbestos mines in India. Here asbestos is dumped in the open. According to a survey conducted by the International Labour Organisation and the assistant director general of mines in November 1978, the Roro mines endangered not only the lives of the mine workers but also of those living in the surrounding areas.

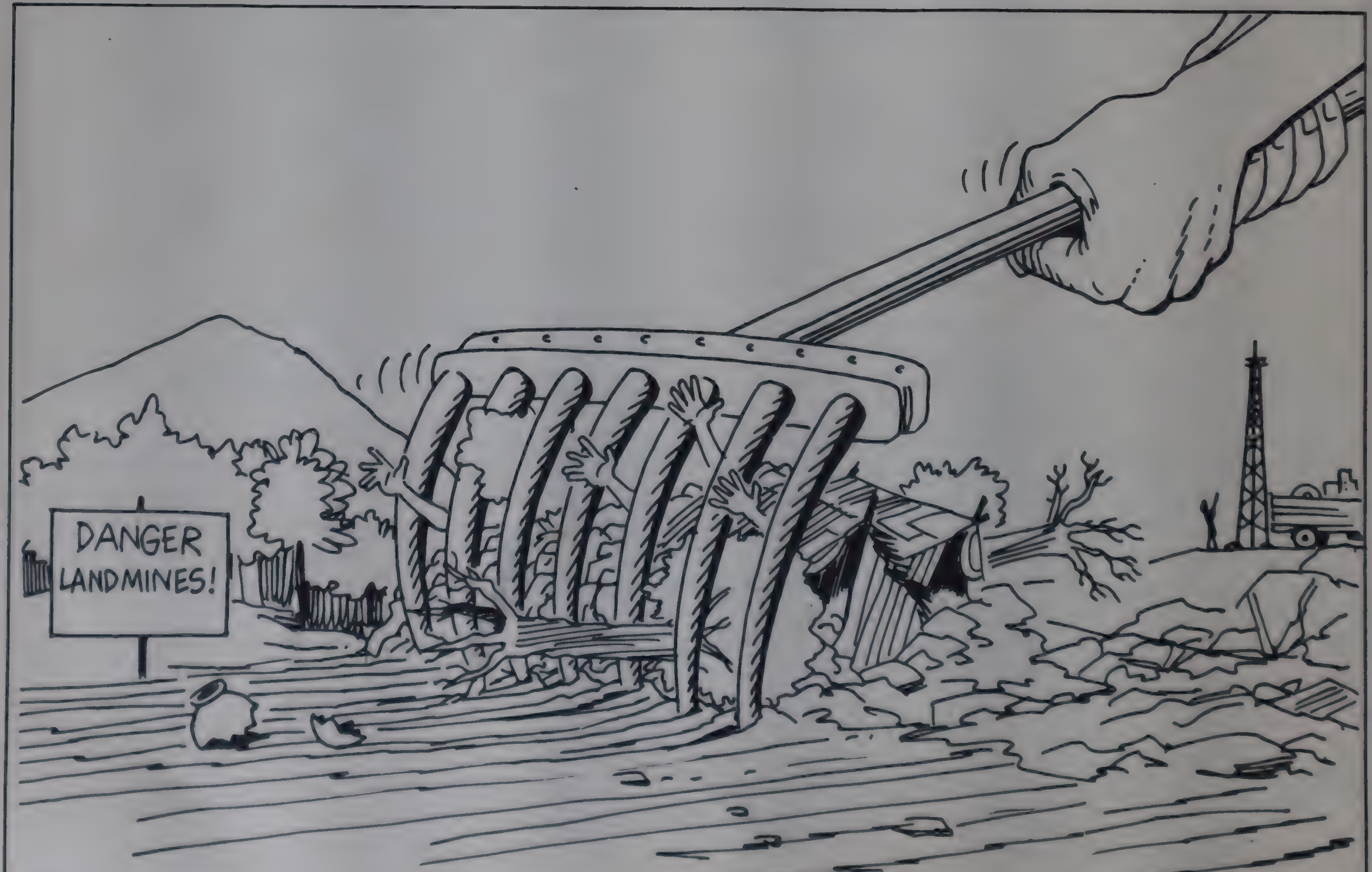
The clustering of mining related units like ore concentrators, crushers and smelters is an additional source of air pollution. Stone quarries and crushers are dispersed around the Delhi-Haryana border. The entire stretch between Faridabad and Badarpur is covered with a thick layer of silica dust. Visibility is reduced and breathing is difficult. Twenty thousand workers and their families breathe the dust, drink it with their water and eat it in their food.

The stone crushed at Badarpur contains 65 per cent silica dust. Prolonged inhalation of the dust causes silicosis. It is characterised by an irritant cough, shortness of breath and pains in the chest. A survey of the health of workers in this area, conducted by Dr Neeraj Sethi of the University College of Medical Sciences New Delhi, shows that 17 per cent of the labourers at the Badarpur crushers are incurably diseased.

Dust generated by mining and mineral-based industries also reduces agricultural productivity. Lead and zinc smelters, limestone quarries and cement factories have reduced land productivity in areas like Udai Sagar, Khamli and Chittor in Rajasthan. Agricultural land prices have declined by about 70 per cent in these areas. Fields in a 10–mile radius around the cement factory at Jhikpani in Singhbhum district lie barren under layers of accumulated dust. Production has fallen from 600 kg per acre to about 200 kg in nearby Tonto block.

## Reclamation

Unless we want to convert several million hectares of India



nto a wasteland, reclamation has to become an integral part f all mining activity in the country. In the United States ederal and state laws require that reclamation plans be filed nd approved before any coal mining permit is issued. "A asic feature of the Federal Surface Mining and Control Act f 1977 is that the land must be restored to its original state r better, after mining, within a specified period of time," ays Professor Mohan Wali of the College of Environmental ciences and Forestry in Syracuse, New York. In India on the ther hand, "there are no existing laws on mining operaions in relation to land improvement and environmental legradation", says R.K. Gupta of the Central Soil Water Conservation Research and Training Institute in Dehra Dun.

If reclamation is made a part of mining operations from he start, it is easier, cheaper and less hazardous to carry out han to reclaim abandoned areas. For example, in surface mining, the first layer of overburden to be removed is the opsoil. The overburden is usually dumped indiscriminately; the fertile topsoil lies at the bottom and poorer earth, mainly clay and gravel, is heaped above it. If reclamation practices are adopted from the beginning, then the overburden can be piled in separate heaps according to the quality of the soil and the planned end use.

Mining waste dumps cause the maximum damage to the environment. Reclamation can be done to minimise their harmful potential. It involves the application of basic principles of soil and water conservation, afforestation, regeneration of vegetation and pollution control.

As far as possible, the waste dumps should be located on barren lands far away from farms, forests and streams. Impervious retention walls need to be constructed to reduce seepage of pollutants. Check dams with water filter beds at the base of the dumps can further reduce the pollution threat. After a dump is filled, it can be stabilised with grass, green legumes and trees. Reforestation can be done after proper appraisal of the climatic topographic and soil conditions. Native species that are used by the local population for fuel and fodder ought to be encouraged. Research done at the Central Arid Zone Research Institute(CAZRI)in Jodhpur shows that abandoned quarries on hill slopes can be developed into pasture. CAZRI scientists have also identified the vegetation most suitable for western Rajasthan.

Land subsidence takes place because protective measures like sand stowing to support mine roofs, adequate boarding and pillaring of the galleries are neglected. When the pressure to fulfil production targets mounts, mine managers cut corners with respect to safety regulations. As a result, roofs collapse, hapless workers die and the threat of subsidence becomes permanent. This is revealed by various reports of official investigations into mining disasters. In the Upper Silesia coal-mining district of Poland, where 42 per cent of all the coal mined in 1970 came from protective pillars, the threat of subsidence is reduced by backfilling the mines with mining wastes. This also reduces the pollution threat. Here, too, the reclamation of mining areas is treated as a component of the coal extraction process.

Enforcement of pollution control legislation, particularly in regions where mining, ore treatment and mineral-based industries are concentrated, is absolutely necessary. Effective pollution control measures are known and the technologies are available. If bag filters and electrostatic precipitators were installed at the ACC cement factory at Jhikpani, agricultural productivity in the surrounding areas would not have fallen so drastically.

### Paradise Regained

Just off the Baroda-Ahmedabad highway in Gujarat are the Sayaji Iron Works Quarry Pvt Ltd. Here basalt rock is excavated, over an area of 200 acres and crushed into stones. While excavation goes on in one area, an adjacent portion has been transformed into a sanctuary.

Abandoned craters have been converted into artificial lakes, dotted with small islands. Fifty thousand trees, local species and bird-attracting types, were planted around the lakes. Fish and aquatic plants have been introduced into the water which teems with aquatic life. Ninety different bird species have been identified here. About 150 acres were thus rehabilitated at a cost of about Rs 150,000 spread over three years. By combining the reclamation operation with the normal mining activity, the costs were minimised.

Sales of babul wood and grass generates Rs 12,000 a year and are expected to increase to Rs 50,000 per year when the trees begin to mature. Till now, most of the wood is sold at subsidised rates to the quarry workers and staff. When more wood becomes available, its sale in the open market will increase income. Currently the lakes are used only for recreational purposes but the potential for commercial pisciculture exists.

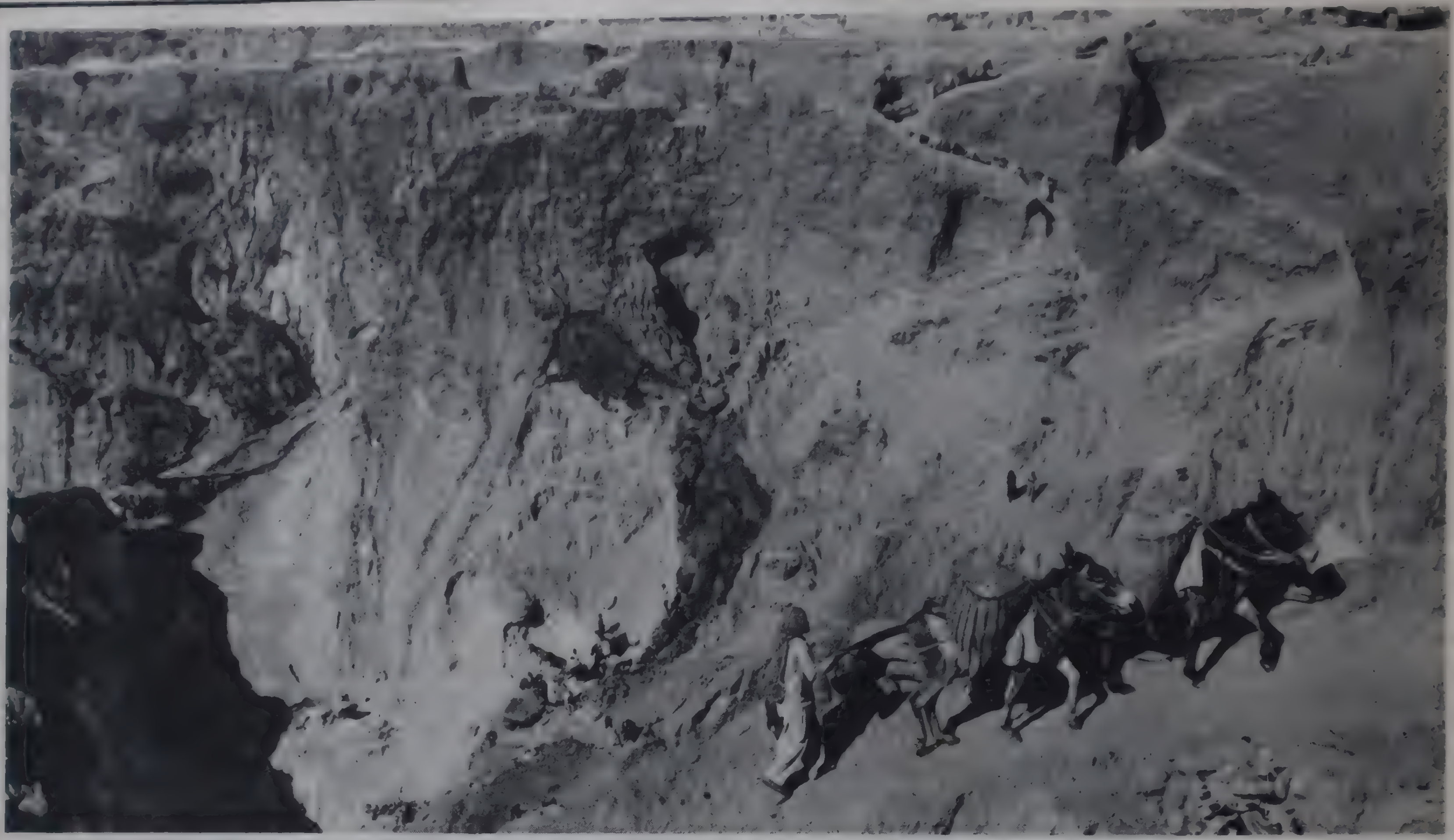
## The politics of mining

Mining is undertaken for several reasons in India: some stated and some unstated. Mines are a crucial source of raw materials for industry. Export of iron ore constitutes about 6 per cent to 10 per cent of India's total exports and thus mines are an important source of foreign exchange. Officially, mining is also justified on the grounds that it brings jobs to "backward areas" and promotes regional development. Among the unstated reasons for mining in India are corruption, profiteering, accumulation of vast hoards of personal wealth, and black money, often used to finance election campaigns. The illegal mining and the illegal practices in legal mining that take place as a result devastate natural resources like agricultural land and forests and loot national resources (just as timber smuggling and real estate scandals do).

In all such operations, safety rules and regulations are ignored making life extremely hazardous for the mine workers. The death of 11 people at the illegal Chapapur Colliery in Dhanbad district recently brought into sharp focus the extent of illegal coal mining that is taking place under the very noses of the authorities and with their support and connivance. The illegal Chapapur mine was being run just 50 metres away from the office of the agent and manager of Chapapur Colliery No 2. These officials disclaimed any knowledge of the illegal mine, even when it was revealed that a colliery bulldozer had been used to bury the victims of the accident.

But even 'legal mining' cannot be said to be without any of the above blemishes. With increasing use of sophisticated machines, limited low-skill jobs become available to the local population, which often consists of tribals. Skilled labour is mostly imported from urban areas. The uprooted local population is then forced into an extremely brutal environment which is highly accident and disease-prone.

The worst aspect of the picture is that even those who are supposed to benefit from all this are not sure if they do. Labour gangs comprising of thousands of adivasis and



**Every day brings new hazards for the miners at the open-cast Bhatti mines near Delhi. Over 400 have died since 1978. (Smitu Kothari)**

## The Pits of Death

Barely 35 km from where members of free India's Parliament sit, thousands of desperately poor workers toil away in the most primitive and dangerous conditions in hundreds of opencast mines situated on both sides of the Delhi-Haryana border. These are the infamous Bhatti mines – total turnover Rs 15 crore and produce among other minerals, red sand, stone and silica, essential raw materials in the construction and glass industry, The labourers—mostly migrants from drought-affected backward areas of Bihar, Rajasthan and Uttar Pradesh numbering between 15,000 and 20,000—work in deep open pits with virtually perpendicular walls hundreds of feet high. All day long, they dangle from ropes to claw the rock faces, earning Rs 15 a day. Says Inder Mohan, general secretary of the People's Union for Civil Liberties (PUCL) which highlighted the plight of the workers: "Since 1978, 400 workers have died and no worker has received full compensation". Most of the deaths occur when cave-ins send tons of debris to crush miners at the bottom of the pits. But still the workers come; one said he was willing to begin work in the very mine where a recent accident had claimed several lives. "We have no choice", he said simply.

The most scandalous aspect of the affair is that the master of the dust-choked hell is the state itself. The mines are owned by the Delhi State Industrial Development Corporation (DSIDC) — which took them over in 1975— and does nothing to enforce even the most minimal of safety regulations. As early as 1970 the Directorate of Mines Safety had classified the Bhatti pits as "the most dangerous mines in the northern India division ".

The contractors flout regulations with total impunity. One of the regulations is that the angle of the mine sides should not exceed 45 degrees and that they should be benched, with the height and breadth of a bench not exceeding 1.5 metres. But at the Bhatti mines, the sides often fall at 90 degrees. Besides, there are no railings around the mines, helmets, boots, cloths and lighting arrangements are nonexistent. The workers even have to pay Rs 10 for every drum of drinking water provided. In addition, although the DSIDC has to provide compensation of Rs 25,000 to Rs 50,000 to the family of each victim, only 10 of the affected 400 families have received Rs 5,000 each when the government's annual revenue from the mines is Rs 4 crore .

The workers of Bhatti also face the threat of silicosis. There is no study available yet either on the extent of air pollution or on its effect on the health of the workers, but activists working in the area reveal that tuberculosis, blood dysentery and seasonal fever is common. In the face of this continuing inhumanity, the powerful contractors get away unscathed — with more than a little help from the powers that be. In August 1981 the mines were shut down after the deaths of a number of workers. However, the materials were urgently needed for the Asiad and the mines were opened.

In April 1983, an inquiry commission was set up under Justice Despande, a former chief justice of the Delhi High Court, to go into the causes of the accidents and corruption in the management. The commission's report said bluntly: "They (DSIDC) are alone reponsible for the accident." The report also stated, equally bluntly: "DSIDC was involved in complicity and or corruption in league with the contractors."

In fact in early '83 when the mines were officially closed, during the course of the inquiry, the contractors continued clandestine mining operations. The DSIDC compounded the felony by exacting levies from the contractors, charging Rs 50 for each of the 250 trucks loaded with red sand that rumbled out of the area every day.

Confronted by the severe indictment of the commission's report the DSIDC took charge of the mines in May 1984. But PUCL which furnished some of the most damning evidence to the Despande commission and continues to investigate the affairs at the mines reports that little has been done to curb illegal mining at Bhatti.

There is clear evidence that the rot is spreading. The contractors have opened up scores of pits in almost every Mehrauli village and in adjoining areas of Haryana. Because of their political clout they have been able to obtain long term leases from the gram sabhas and short term permits from the administration. And a contractor boasts, "For 100 mines the government closed 1,000 mines have been opened."

The DSIDC has started digging its own mine on two acres of land, but progress is slow and they seem content to let the contractors rule the roost.

### Quarry Peril

Dust, funereal white, hangs heavy in the air of Jhiroli village in Almora district of Uttar Pradesh. It has been kicked up by the magnesite mines of Almora Magnesite Ltd, which are spread over 432 acres, yawning white chasms which have already yielded 4 lakh tonnes of the mineral. Total deposits are nearly 4 million tonnes and it will be quite a while before Jhiroli's treasure-house is swept bare of its last chunk of magnesite.

By that time, of course, Jhiroli will have ceased to exist. Already the strain has told: the dust of processed magnesite has settled on its fields like the eleventh plague, rendering them totally barren. The blasting at the mines has caused cracks in the houses. Deprived of their land, the villagers have had no choice but to report for work as miners.

There are scores of Jhirolis dotting the once proud Himalayan foothills, prey to the quarries which have mushroomed all over the area in recent years. With the pressure mounting from environmentalists to abandon quarrying in Mussoorie hills, mines are springing up in more remote Himalayan regions—also more fragile and vulnerable to mining havoc. Today in the Kumaon region alone as many as 18 units are in operation.

More are on the way: Bharat Refractories Ltd is to start the region's biggest-ever quarry at Devalthal in Pithoragarh district. Cement units have been slated for Khairna in Almora district and for Gangolihat in Pithoragarh district and the raw material for them will be mined locally. Others are slated for remote villages in the Pindar valley known to be prone to killer landslides.

In Himachal Pradesh the state government has issued licences for the setting up of three large cement plants and 19 small sector and 14 mini cement plants throughout the state which will produce 20.41 lakh tonnes of cement annually. Limestone deposits of about 10,000 million tonnes have been identified at 14 places in the state.

The havoc wrought by the quarries is depressingly similar all over the area. For instance, the magnesite quarry above Chandak-Sikhrana village in Pithoragarh district was the source of a substantial amount of debris which descended on the fields with the monsoon. At the same time, the thick fumes from the rotary kiln, set up to partially process the ore, settled and solidified on both pasture lands and fields. Villagers tell of how springs have dried up, cattle come down with strange new diseases and production has declined dramatically. The villager's economic gains are pitiful compared to the losses also because the entrepreneurs from Calcutta brought in outside labour which acted as a buffer between the management and the local people.

That is one way of insuring against trouble. The owner's most powerful weapon is employment. By giving jobs to a few unemployed young men and appointing an influential local person as manager, they ensure smooth operation. The owners do not hesitate to encroach upon public land if they feel it is profitable to do so: Orissa Magnesite Ltd for one, has encroached upon and taken illegal possession of panchayati land in Chhanadunga village in Pithoragarh district.

The workers toil in inhuman conditions, often working for 12 hours a day at a pittance of Rs 10 a day. Safety regulations are observed mostly in the breach, although accidents are usually, and quickly, hushed up. In the Orissa Magnesite Ltd mines, nine workers are reported to have died in accidents but no word of this has leaked to the outside world.

There is evidence that the villagers are not going to take it any longer. The women of Khirakot got together to put a stop to the soapstone mines of a Kanpur company in an epic and landmark battle that lasted years. Ironically, the same contractor was granted the lease for another village. Residents of Rima village, periodically hit by landslides, managed to get quarrying suspended. The youth of Gariya Gadhera village near Kapkot grabbed tools from miners and sent them packing. Earlier the local administration had ignored their request that something be done about the quarries whose debris was choking the streams. In Pithoragarh there is an emerging movement, uniting the local people against the mining devastation.

Whatever the outcome of the struggle between ecology and industry the people are likely to get the worst of it. When the mines swallow their land, they cannot be settled nearby as every square metre of land in the hills is now protected forest land—even if there isn't so much as a blade of grass on it. And resettlement will most likely be lackadaisical. In the Jhiroli case, for instance, only 10 per cent of the total number of people displaced have been given an acre each in the terai, which in any case is too far away from the village.

The forces lined up against the people of the Himalayan foothills are powerful indeed: Jhiroli's Almora Magnesite Ltd is jointly owned by the Uttar Pradesh government, the Tatas and the Steel Authority of India, who between them can work up a fair amount of clout. The only hope lies in the Central government's order that all demands on land in these hills be referred to it. In fact, Almora Magnesite had to fight hard to get its lease renewed. Unfortunately, it was: the fight goes on.

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peasants, women and children, scrabble in the hot sun separating coal from shale, breaking metallic ores with hammers and crowbars. Every drought and famine, intensified by deforestation and the destruction of agriculture, forces more people to join these gangs. Thousands work without any hope of regular employment, and those that have it remain emaciated and fearful for their lives in an accident-prone activity. For the large masses of people, this is the meaning of the phrase "development of backward areas".

The worst affected are the tribals of central India, whose lands and forests have been extensively destroyed by mining and associated industries. No less than eight superthermal power stations are planned in a cluster next to the coal mines of Singrauli. Similarly all the major steel plants, including the proposed plant at Vishakhapatnam, are concentrated in the Bhilai-Bokaro-Rourkela-Jamshedpur-Durgapur-Burnpur region. Then there are the copper complexes in Bihar and MP, aluminium industries in MP and Orissa, and innumerable cement, automobile and other engineering plants, all inter-connected by railway lines and road networks, together with rail sidings and stockyards. The environmental effects of mining are thus multiplied a hundredfold by the industry that follows.

There is an irony in calling resource-rich areas like Chattisgarh backward areas. Chattisgarh was once a rice bowl with fertile lands and flowing rivers. Today, part of the mining heartland, the poverty-stricken Chattisgarhis move around as unskilled mine workers or as construction workers in Delhi, under oppressive contractual conditions.

Macro statistics do not show that mining makes the land much more profitable than agriculture. In 1981-82, some 143 million hectares of land produced some Rs 46,800 crore worth of agricultural goods, about Rs 3,270 per hectare. The mines spread over 5 million hectares to 15 million hectares earned only about Rs 3,400 crore that is, between Rs 6,800 and Rs 2,266 per hectare. From these earnings must be subtracted the environmental cost of natural resource destruction and of rehabilitation. Thus, incomes may not go up much or even at all as a result of mining. But it definitely transfers the benefits to the more powerful groups in society. And that, for the moment, seems to be all that matters.

# WATER

*Today, India uses only a tenth of the rainfall it receives annually and even 40 years from now, will be using only a quarter. But it must learn to store the water and use even the fraction it uses without polluting it, otherwise there will be serious water shortages.*

*India's groundwater resources are almost 10 times its annual rainfall. But with over 170,000 tubewells added every year during the 1970s, the water table is declining in many areas, leaving the dugwells of the poor high and dry.*

*Ancient India stored rainfall in tanks and ponds but the British and the independent Indian administrations have neglected them, so where tanks irrigated half the cropped area a century ago they now irrigate less than 10 per cent. Experts calculate that tanks built over 3 per cent of India's land area could store a quarter of its rainfall.*

*All but two of the high-altitude lakes in India are steadily dying because of pollution. The slow death of Kashmir's Dal lake is threatening the livelihood of 50,000 fisherfolk.*

*The ecological value of wetlands has yet to be understood. Calcutta's Salt Lake City today stands on a former sprawling wetland and the result is, with the city's natural drainage system blocked, every shower turns into a flood and the city has lost a major source of fish, its favourite food.*

*Increasingly polluted rivers and lakes and large dams are seriously affecting riverine fisheries. The migratory hilsa, a much sought after delicacy, is being dammed to death.*

*Millions of riverine fisherfolk, their very survival uncertain, now travel long distances and months in search of fish.*

*Dam waters now cover nearly one per cent of India's land area, but produce little fish and provide little employment for the impoverished fisherfolk: the highest annual yield of a reservoir is only 190 kg a hectare annually, but some fish ponds record 8,000 kg a hectare.*

*India's inland fish catch is growing, mainly because of the spurt of aquaculture in private ponds controlled by rich farmers, even as pollution snatches away from millions of poor fisherfolk their livelihood.*

India is one of the wettest countries in the world. Its average annual rainfall is 1,170 mm, with Cherrapunji in the northeast corner getting drenched under 11,400 mm and the sands of Jaisalmer at the other end of the scale pulling along with 210 mm. Considering that the midwestern United States — the breadbasket of the world — gets an average of 200 mm a year, India should consider itself singularly blessed.

Unfortunately, the country has a singular habit of not making use of its blessings. Even though by 2025 A.D., India will use only a fourth of the total annual rainfall, it is expected to face the threat of shortages two decades from now. The reason for this is simply that India cannot hold on to all the water it receives.

Deforestation is, of course, a major factor in this gloomy scenario. Soil conservation has so far been conspicuous by its neglect, so that a large portion of the monsoon disappears into the sea as surface runoff. To add to the problem, community resources such as ponds, tanks and rivers are the object of continuous and unchecked misuse. The ponds and tanks are fading out through neglect and groundwater is increasingly becoming a private resource through the increasing use of tubewells. Rivers, the biggest source by far, are convenient dumps for urban and industrial wastes.

Once ponds and tanks represented an important community resource in rural India. Villagers all over the country would desilt their water bodies. In some parts special festive days were set aside for desilting operations. In north India, villagers would use the fine silt to coat the walls of their homes. In Bengal, the mud would be used to make houses. In south India, people used it as manure because of the organic content of the decaying vegetable and organic matter.

Indian water policy, if there is any such animal, has so far concentrated on highly visible large dams, reservoirs and canal systems, ignoring the highly cost-effective minor water projects such as tubewells, dugwells and tanks. However impressive the dams sound in press handouts, it is a miserable fact that India has so far not managed to arrest the devastating annual cycles of floods and droughts.

The state of India's water establishment can be gauged from one fact: there is yet no detailed survey of how much water there actually is in India. The Central Ground Water Board (CGWB) announced recently that it expects to complete a nationwide survey between 1990 and 1995. By that time, if the present predictions are anything to go by, India will already be coping with the beginning of dry rot.

This chapter begins with an outline of India's water budget. Issues related to the use of groundwater through tubewells and of surface water through tanks are discussed next. Since pollution and impoundment of rivers continue to grow, the chapter also highlights their effect on fisheries, an important source of protein in India.

# INDIA'S WATER BUDGET

Despite an increasingly desperate situation, India continues to use its water resources as if the supply is assured. Sudhir Sen, a former chairman of the Damodar Valley Authority, ascribes this to planners' "resource illiteracy"

It is difficult to prepare an accurate national picture of India's water resources because accurate field data is almost non-existent. "Unbelievable as it may seem, till now we have no arrangements in this country to compile and publish on an annual basis, comprehensive data regarding various aspects of water which are important for policy analysis and programme formulation and for monitoring the efficiency of use of our scarce water resources," wrote Dr Narottam Shah, director of the Bombay-based Centre for Monitoring Indian Economy, in a paper prepared for the Central Statistical Organization in 1983.

The water flow chart shown is an attempt to quantify the hydrologic cycle, by B.S. Nag and G.N. Kathpalia of the National Commission on Agriculture. The figures in the chart are only approximate estimates. For example, their estimate of groundwater use in 1974 and ultimate potential, differ from figures recently released by the Central Ground Water Board (CGWB). The chart's true value lies in showing the current and future water resources and use patterns. These estimates show that out of the annual precipitation of 400 million hectare-metre (mham) the water utilisation in 1974 was only 38 mham (9.5 per cent). In 2025 it will rise to 105 mham (26 per cent). The latter figure represents the maximum usable potential according to Nag and Kathpalia.

The 400 mham of rainfall that India receives every year are distributed in three basic ways: 70 mham evaporate immediately, 115 mham runoff into surface water bodies and 215 mham percolate into the soil. The next stage is a series of interchanges between these three sinks. Finally, almost all the precipitation is returned to the atmosphere.

Through transpiration, plants use a large fraction of the water that percolates into the soil and thereby sustain good growth. People draw water from surface and underground sources to fulfil their domestic, irrigation, commercial and household needs.

The total annual surface flows from direct runoff (115 mham), streams and rivers entering from neighbouring countries (20 mham), and underground water courses add up to 180 mham. Of this supply, 15 mham are used through diversion works and by direct pumping. The remaining 150 mham go into the sea or into neighbouring countries. In the year 2025 AD., it is expected that storage (35 mham) and direct pumping (45 mham) will consume 80 mham out of an increased surface flow volume of 185 mham. The extra 5 mham will be the enhanced return from the increased surface irrigation.

Out of the 215 mham percolating into the soil, 165 mham moisten it and the remaining 50 mham enter the groundwater table. During the rainy season, the water surface of a river is generally at a higher level than the adjoining water table. Due to this gradient, river seepage adds about 5 mham to the groundwater supply. Another 12 mham are added from leakage due to irrigation, raising the total groundwater recharge to 67 mham.

The rise in groundwater use in the coming years will result in a steeper gradient and higher seepage from river beds. Percolation from irrigated fields will also increase as irrigation expands. The higher inflows will raise the total annual groundwater recharge to 85 mham. Any techniques employed for soil conservation, for example, revegetation or bunding, will also raise the infiltration into the water table. The extra groundwater will provide more water for direct use and regeneration of nearby river flows.

The total groundwater recharge is dissipated through evapotranspiration, extraction for use through tubewells and dugwells, or it finds its way through underground streams into local river beds. Any portion not used in these ways raises the water table, leading to increased evapotranspiration. By 2025 AD., the level of extraction is expected to increase steeply from the present level of about 13 mham to about 35 mham.

**Water demand**

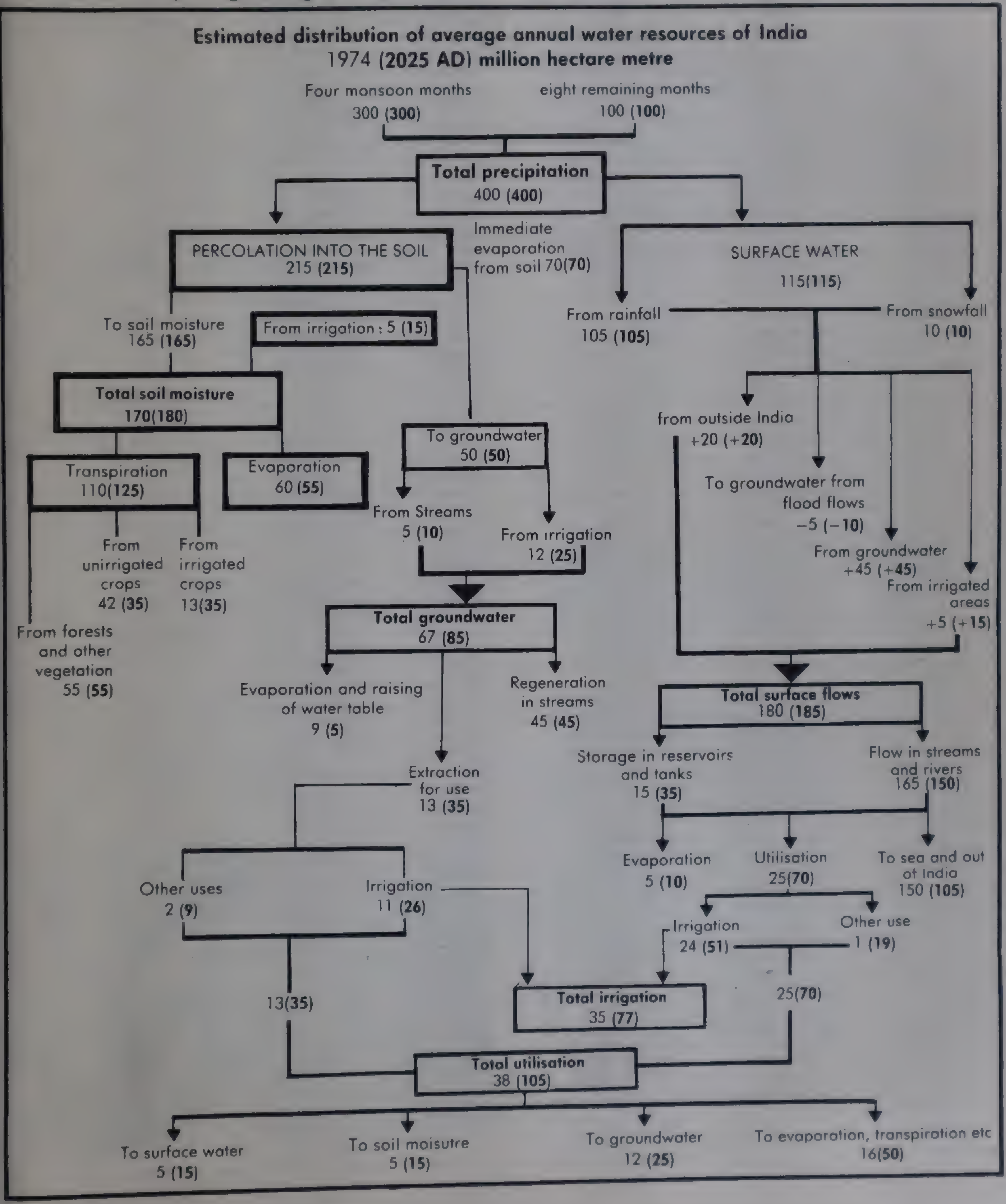
The main demand for water is for irrigation. In 1974, irrigation used about 92 per cent of all the water consumed in the country. Domestic and industrial uses accounted for the remaining 8 per cent. Water scarcity in rural areas or the lack of access to it, forces people to consume less. Even if all domestic and industrial needs are adequately met by 2025, irrigation withdrawals will be almost 73 per cent of total water consumption.

How much of the annual precipitation can be realistically exploited? Estimates range from 86 mham to 105 mham. Scientists at the Indian Agricultural Research Institute in New Delhi calculate an ultimate usable potential of 86.5 mham, while a team of Indian and American experts estimated it at 92.7 mham. In both cases it was assumed that the present levels of use efficiencies will prevail. Nag and Kathpalia arrived at a higher figure of 105 mham, by assuming recycling of municipal and industrial waste waters, as well the use of new water technologies.

Even the maximum usable water supply of 105 mham will be inadequate to meet the various water demands by 2025, 40 years from now. A grimmer picture emerges from the projections of Professor M.C. Chaturvedi of the Indian Institute of Technology, New Delhi. Professor Chaturvedi predicts a state of nationwide inadequacy in the next decade itself. The differences in these predictions arise mainly from Chaturvedi's estimates of a lower figure of 92.7 mham for the ultimate usable potential, and a higher rate of water use for irrigation. Nag and Kathpalia base their figures on the assumption that water use in irrigation will become more efficient, whereas Chaturvedi assumes that the current patterns will prevail, at least till the end of this century. Both sets of projections were prepared almost a decade ago. So far, events seem to be proving the pessimistic assumptions of Chaturvedi to be more realistic.

Professor Chaturvedi has also calculated that there will be a sharp increase in the effluents from industrial users, thereby escalating the pollution threat. Increased power generation will raise the amount of thermal pollution with the warm waste water, leading to a decline in the dissolved oxygen content of the receiving water bodies. "We are faced with serious problems. Utilisable resources will be exhausted in several river basins, the pollution problem will be serious in all the river basins and the environmental deprevation will be universal well before the turn of the century. The frightening message is that . . . such a situation s bound to emerge unless we plan boldly and immediately, ’ he comments in an epilogue to his projections.

Despite these disparate figures, few planners, politicians and administrators appear to be concerned about the seriousness of the situation. Regional water shortage are nevitable and likely to increase particularly in the arid and semi-arid areas. The prolonged droughts in Rajasthan and Tamil Nadu in the last two years could be forerunners of impending nationwide crises. Good rainfall areas may also be in for trying times. The Ganga is a perennial river and its basin is one of the most well-endowed water regions in the world. But it is also a very densely populated area. Even at present, the dry season flow of the Ganga is barely sufficient for the needs of India and Bangladesh.


**Estimated distribution of average annual water resources of India**
1974 **(2025 AD) million hectare metre**

Four monsoon months
300 (300)
eight remaining months
100 (100)
Total precipitation
400 (400)
PERCOLATION INTO THE SOIL
215 (215)
Immediate evaporation from soil 70(70)
SURFACE WATER
115(115)
To soil moisture
165 (165)
From irrigation : 5 (15)
From rainfall
105 (105)
From snowfall
10 (10)
Total soil moisture
170(180)
To groundwater
50 (50)
from outside India
+20 (+20)
Transpiration
110(125)
Evaporation
60 (55)
From Streams
5 (10)
From irrigation
12 (25)
To groundwater from flood flows
−5 (−10)
From groundwater
+45 (+45)
From irrigated areas
+5 (+15)
From unirrigated crops
42 (35)
From irrigated crops
13(35)
From forests and other vegetation
55 (55)
Total groundwater
67 (85)
Evaporation and raising of water table
9 (5)
Regeneration in streams
45 (45)
Total surface flows
180 (185)
Storage in reservoirs and tanks
15 (35)
Flow in streams and rivers
165 (150)
Extraction for use
13 (35)
Evaporation
5 (10)
Utilisation
25(70)
To sea and out of India
150 (105)
Other uses
2 (9)
Irrigation
11 (26)
Irrigation
24 (51)
Other use
1 (19)
13(35)
Total irrigation
35 (77)
25(70)
Total utilisation
38 (105)
To surface water
5 (15)
To soil moisutre
5 (15)
To groundwater
12 (25)
To evaporation, transpiration etc
16(50)

## Disaster-Prone Poor

The 1970s saw an increasing sense of futility in the world's premier relief agency, the Red Cross. Even as the number of international disaster relief appeals and disaster relief works increased steadily, the number of disasters and the number of people affected by these disasters also grew. It soon dawned upon the Red Cross: the world is becoming a more hazardous place to live in.

A detailed study commissioned by the Swedish Red Cross found that from the 1960s to the 1970s the average number of disaster events per year increased by half, the average number of people killed per year in these disasters increased over six times and the average annual number of people affected by them almost doubled — an increase that could not be justified merely by population growth. The Swedish Red Cross study concluded: "some disasters, particularly droughts and floods, have become seemingly endless processes that grow only larger and larger." Increasing environmental destruction is increasing the hazard-proneness of the environmentally affected areas and increasing poverty is making large, and growing, numbers of people more vulnerable to these disasters. Within the Third World, these two facts — poverty and environmental destruction — combine to create a literally 'disastrous' situation.

Poor people in poor countries are affected the most when a natural disaster strikes: when hurricanes hit the US coast they kill a few people but when they hit India or Bangladesh they leave thousands dead in their wake. Within a country, natural disasters are almost choosing their victims by class — the poor living on the margins of the environment. Many natural disaster experts now argue that so-called 'natural' disasters (floods, droughts, cyclones, landslides and earthquakes) are equally social and political disaster events. We are no longer dealing with 'disaster events' but 'disaster processes'.

Asia is the most disaster prone continent and India is high on the Asian list. Between 1960 and 1981, 96 disaster events killed 60,000 people in India — 25,000 in cyclones and 15,000 in floods. Floods are particularly a major problem in India. Global statistics show that 70 per cent of all flood victims between 1960 and 1981 lived in India and Bangladesh. The last 30 years' statistics, that on average some 1400 people and over 1,00,000 heads of cattle perish every year in floods. The danger from floods is growing rapidly in India. According to a recent FAO estimate, more than one-third of India's population — 250 million — now live in areas that may be affected by floods in any year.

Droughts affect more people in the world than any other form of natural disaster. Global statistics show during the 1960s and 70s the largest number of drought-affected victims lived in India. Even in the 1970s. a decade known for the Sahelian drought in West Africa, 80 per cent of the drought-affected populations were living in India. By 1983, however, Africa had surpassed India for the first time in the number of drought-affected victims.

The most flood prone areas are in the Ganga and Brahmaputra basins—annual flood damages in the Ganga basin states alone account for about 60 per cent of the total. In the fifties and sixties, Uttar Pradesh, Bihar, West Bengal, Orissa and Assam used to account for three fourths of flood damage. But between 1976 and 1978 Andhra Pradesh, Rajasthan, and to a lesser extent Gujarat and Haryana, which lie outside the traditional flood zone were also affected, accounting for about half the total damage in the country. In traditional flood prone areas like West Bengal, matters have become worse because of the increased use of flood plains for agriculture and urbanisation and unplanned development of flood prone areas. Says an Oxfam report on disasters in West Bengal: "Floods are now an annual feature and there are many flash floods. The extent of the damage shows a pattern of increase from west to east (downstream along the Ganga) and from south to north (toward the hills)."

The loss is staggering. In the five-year period 1974-78 flood losses averaged Rs 845 crore a year—about 14 times higher than in the mid-fifties. Total damage to agriculture and urban property from 1953 to 1983 is estimated at Rs 14,200 crore, an annual average of Rs 458 crore. The year 1983 was the worst so far; damage estimated at Rs 2,292 crore, despite the fact that until March 1984, 12.44 million hectares of flood prone areas had been protected and the total outlay for flood control in the sixth plan, Rs 1,045 crore, is more than the total expenditure on flood control in all the earlier plans.

Actually, the damage loss figures may be gross underestimates. A.N. Malhotra, retiring chairman of the Brahmaputra board, claimed in early 1984 that the annual flood damage to Assam alone should be Rs 2,000 crore. "Nearly 30 villages have been eaten up during the last 25 years in the Moriahola area alone", he said. The high water mark at Dibrugarh on the Brahmaputra river has risen gradually over the past 40 years, and since 1960 it has always been above the "danger mark". The year 1984 has not so far been very reassuring. By August, there had already been two waves of floods, including an unusual premonsoon wave, affecting over a million people in the Brahmaputra valley. Large parts of Gauhati had been inundated. The majority of the Barak valley's 105 tea gardens were damaged.

Heavy releases of water from the dams of the Damodar Valley Corporation (DVC) played a major role in massive flooding in south Bengal, where nearly 10 districts and 3 million people suffered. DVC Chairman Lt Gen M.M. Ghai admitted that the importance of DVC in flood control had come to be forgotten over the years. The releases from Panchet reservoir, which caused the floods, were entirely avoidable. The spill gates of the small Tenughat dam built by the Bihar government higher up in the watershed and connected to Panchet by a channel were in a state of disrepair. The Tenughat dam could not hold the rainwater back, diverting it to Panchet, leading to an inundation of Howrah. Hooghly and Midnapore districts. Ghai's proposed solution, ironically, is to build even more dams. He claimed that the DVC, which had earlier planned for eight dams, had built only four.

The response of the Central and state governments to the national calamity of floods is typical. The model bill for flood plain zoning has been literally floating around since 1974. It had been sent by the Centre to the states, as a blueprint for legislation which will enable them to regulate development activities in flood prone areas. But no state government has shown any interest in the bill.

The Red Cross at least has realised that distributing blankets and medicines at the end of each disaster or calling out the army to row boats is totally ridiculous. The important thing is to get in front of the disasters and stop them from happening — by stopping the environmental change that is making the environment more hazard prone. Disaster prevention is more important than disaster relief.

FAO

## Dry Rot

One state which can be said to have suffered more than its fair share of water shortages, and their attendant horrors, is Tamil Nadu. By early 1983, the state had been brought to its knees by a series of drought years which began in 1980. In 1982, for instance, when the southwest monsoon failed, half the standing crops withered in the fields. The water table levels declined to frightening levels in a number of districts. By January 1983, hydroelectric power generation was a mere 130 mw, against the usual 1,369 mw, reducing total power supply in the state by 40 per cent. Madras cut water supply to a daily two hours on alternate days. Agricultural labourers migrated to neighbouring states and more than a million unionised labour became idle.

Tamil Nadu's suffering, however, was more the result of neglect than a natural calamity. Nearly 64 per cent of the state's area is drought-prone and any rational policy of water management should therefore concentrate on conserving a maximum amount of the annual rainfall. Only 27.5 per cent of the statewide annual precipitation is utilised; the rest either evaporates or runs off into the sea. Tamil Nadus politicians and bureaucrats have found it more convenient to import the deficit from the neighbouring states.

A number of factors are responsible for Tamil Nadu's inability to hold on to its rainwater. The most significant is the massive deforestation of the last few decades. Secondly, with the advent of high yielding seeds, the state government has encouraged tubewell irrigation in a big way, without augmenting the groundwater recharge. As a result, the water table has declined in a number of places. Finally, in urban areas, lakes and ponds have been filled up and built upon. "Nearly 50 years ago, there was a huge lake eight miles long and one and a half miles wide a few miles south of Thiruvanmiyur. This lake bund has totally disappeared and colonies have sprung up on the foreshore all around by unauthorised encroachments," writes R.K. Murthy, a resident of Madras, in 'The Hindu'. In a more enlightened era, Tamil Nadu was a land of lakes, tanks and ponds.

The people now look to the government for solutions and the government reacts in typical short-sighted fashion. To counter the drought, for example, it has ordered dug thousands of deep wells which will further lower the water table. It also proposed to spend Rs 760 crore on a 480 km long canal, the famous Telugu Ganga canal to bring water from the Srisailam dam in Andhra Pradesh. But doubts persist about this grandiose scheme: plans announced with equal enthusiasm in the past for exploiting the Cauvery river were scrapped later.

No politician has said a word about rational resource management. But then, Tamil Nadu's political leadership is drawn from its movie industry. And that movie industry has specialised in the making and selling of fantasies.

## Nature's Revenge

The battle for Kerala's Silent Valley has been won, but the war over its natural wealth is nearly lost. The state's forest are being systematically slaughtered. The best symptom of the deepening natural sickness was the unprecedented drought that Kerala suffered in 1983, which led to the paddy crop being badly damaged, the complete failure of the 1982–83 cardamom crop, power cuts—generation is entirely hydel—and crippled industrial activity.

Over 80 per cent of the state's average annual rainfall of 3,200 mm comes in about six months: the south-west monsoon (June – September) brings in two-thirds of the water and the north-east monsoon another sixth. All the state's 44 rivers, monsoon-fed torrential streams, would be seasonal were it not for the forests covering the mountain slopes which store water and feed the rivers the year round. But the forests are no longer there: according to B.L. Verma of Action for Food Production, Delhi, who prepared estimates after deducting area lost to development and timber exploitation, the area under forest is now a meagre 13 per cent of the state's area — a frightening statistic considering that 90 per cent of Kerala's total area is made up by the Western Ghats.

The rape continues unabated. For instance, Kerala depends entirely on hydel power: there are nine completed projects with an installed capacity of 1,011 mw, three are under construction and at least nine more locations are being investigated. In fact less than 40 per cent of the hydel potential has been exploited as yet. The power rush has led to a vicious circle: the only remedy for the regular power cuts during summer is more dams, which further damage the catchment area, reduce water availability and consequently the power generation capacity of the project.

The result, according to Dr Santhi Nair an environmentalist based in Kerala, is that "every river basin in Kerala is today seriously damaged". Officially, there are 0.94 million hectares of forests in the state but, according to Santhi, "unmodified forests capable of carrying out their ecological functions are only a small fraction of this, may be only about 70,000 hectares at the most. Yet the pressure to destroy forests is mounting."

Timber is a major source of revenue for the state — in 1982–83, out of a total non-tax revenue of Rs 56 crore, timber and other forest produce accounted for Rs 53 crore.

The 0.48 million hectares of tropical evergreen and semi evergreen forests of the state, found in the vulnerable catchment areas, have been ransacked to provide timber to plywood and rayon industries and sacrificed to river valley projects. Moist deciduous forests of the state have been converted to monoculture plantations. More than 0.14 million hectares of once deciduous forests are now plantations of teak and eucalyptus, most of which have been a failure all over the Western Ghats.

The state government has as many as 15 corporations to undertake forest and agriculture plantations. Professor M.K. Prasad of the Kerala Sastra Sahithya Parishad (KSSP), which spearheaded the Silent Valley campaign in the state, blames this multiplicity of authority as the major cause for deforestation. "These 15 corporations set up to satisfy portfolio-hungry ministers in the coalition government have only served to further decimate the forests. Now with ease, forest areas are being transferred to rubber and cashew plantations." In its bid to remain in power the coalition government has more than once sacrificed the forests to votes by giving forest land to the encroachers (see box 'The Spreading Rot').

The portents are there for all to see. Nearly 40 per cent of Kerala's paddy area is unirrigated because of the hilly topography — most paddy lands in mid-Kerala are located in small watersheds called 'elas'. But the hills have been brought under tapioca, rubber and cashew and any slight shift in the rainfall pattern affects the elas because the hills can no longer retain water.

Coconut cultivation has also been extended into the hills and in unsuitable terrain a slight dry spell affects the crop adversely. Large areas of forests have been cleared for plantation crops like coffee, tea and cardamom, which are humid tropical crops and need high rainfall, cool unvarying temperatures and fertile soils. As long as small plantation areas were surrounded by vast stretches of forests the normal range of environmental fluctuations did not matter. But now, with the forests almost completely vanished, this buffer effect is also gone.

Stirred by the crisis caused by the drought, the opposition parties in Kerala launched a rail-roko agitation against the Centre's failure to give funds for drought relief. But it was the KSSP that organised statewide activity against deforestation. It held meetings in every district and elaborated the effects of deforestation to the people. It also mobilised protests at the district and state level and initiated a mass signature campaign.

# GROUNDWATER

For a country which faces the big thirst 20 years from now, groundwater and its proper use is crucial. An accurate picture of India's groundwater resources and use is not readily available. However, guesstimates are: groundwater reserves at a depth of 300 m are said to be about 3,700 million hectare-metres (mham), almost 10 times the annual rainfall. The bulk is non-replenishable, like coal. The Second Irrigation Commission of 1972 estimated the total annual recharge from rainfall and seepage to be about 67 mham. This figure can increase with the development of water systems which add to the recharge. Also, recent investigations show that the 'hard-rock' formations of peninsular India — nearly 70 per cent of the country's land mass — hold more groundwater than was assumed earlier. Thus, the most up-to-date figures by the CGWB put the annual exploitable potential at 42.3 mham, of which only 10 mham are being exploited at present.

Many observers regard the widespread use of groundwater irrigation in the Indo-Gangetic plains to be the key to the spread of the Green Revolution. "It is not a mere accident that the Green Revolution should first have taken root in precisely those regions — the alluvial plains of the Northwest and the South — where groundwater is not only most readily available but has also been tapped for irrigation to the greatest extent," says B.B. Vohra, former chairperson of CGWB.

Groundwater use offers a number of advantages when compared to surface water. Groundwater reservoirs do not suffer seepage losses like surface reservoirs and evapotranspiration losses are also minimised. Groundwater can be developed quickly and near the place of use, whereas surface water storage reservoirs require suitable sites and costly distribution systems. Groundwater is less likely to get polluted and the expenditure can be recovered faster. It is also a remedy for waterlogging, particularly where the water table is high.

One of the most popular ways of using groundwater is the tubewell. Tubewell irrigation in India began 50 years ago with the development of public tubewell irrigation in Meerut district of Uttar Pradesh in the mid-thirties. It was estimated that in 1950-51 there were about 5,000 tubewells all over India—as opposed to 3.9 million dugwells. The nationwide droughts and near famines of the sixties boosted tubewell technology to the extent that the stock of private tubewells grew by about 172,000 a year in the last decade compared to 50,000 and 2,000 a year in the sixties and the fifties. As Professor B.D. Dhawan points out in his book 'Development of Tubewell Irrigation in India', "the annual addition to the stock of private tubewells during the seventies is comparable with the corresponding increment to the stock of dugwells in the whole country, not to mention that it is a hundred times that of the public tubewells."

The phenomenal growth of tubewell irrigation in the alluvial tracts of India is related to the ease of tapping the water and the fact that its operation is directly under the control of the farmer. This enables farmers to supply adequate amounts of water at the right time to the crops. In contrast, in canal irrigated areas, the supply of water is in the hands of inefficient and often corrupt bureaucracies.

Data for 1977 shows that about 90 per cent of all tubewells were located in Punjab, Haryana, Uttar Pradesh, Bihar and West Bengal. The sandy aquifers of the Indo-Gangetic plain make the construction of shallow tubewells, also called filter points, within the reach of individual farmers. In the seventies, when the growth was at its peak, the total cost of a private tubewell rarely touched Rs 10,000. By contrast, in the hard-rock areas, where groundwater is often located at depths of 1,000 ft, the cost is greater than Rs one lakh, which means that either the state has to chip in or that the tubewell has to be a community effort.

Tubewells are primarily used for irrigation, though they also serve domestic needs. In arid and semi-arid areas, hand-pump fitted tubewells have been immensely useful in meeting domestic water requirements. In 1961, tubewells irrigated 258,000 hectares, or only one per cent of the country's net irrigated area; by 1974, they irrigated 5.56 million hectares, or 17 per cent. In the same period, the total area irrigated by dugwells stayed at 7.5 million hectares.

## Growing misuse

The spurt in the number of tubewells is an indication of the increasing use of groundwater. As in the exploitation of almost every resource in this country, there is more than a suggestion of misuse. For one, the water table is declining. Groundwater withdrawals consistently exceeding the recharge lead to a permanent decline in the water table. Inevitably, there is little official or authentic data on the extent of the decline. One reason is that the state groundwater boards have just begun work. The other reason is political. Says Dhawan: "This resistance is attributable to political considerations, in the sense that regions experiencing decline in water table are not likely to get institutional finance for state proposals to develop more tubewells in such regions."

Dhawan lists six districts in the west Indo-Gangetic plains where the annual withdrawal of groundwater exceeds the recharge: Kapurthala and Malerkotla in Punjab, Mohindergarh in Haryana, Baghpat, Alipur and Saharanpur in western Uttar Pradesh. The surge of tubewell irrigation in Punjab and Haryana peaked in the mid-seventies and then fell because there wasn't enough groundwater to go around, and Dhawan expects that the ceiling of 850,000 private tubewells in these states will be reached by the mid-eighties.

The decline in the water table affects poor farmers the most — the richer ones can dig deeper and stave off disaster. Users of dugwells and those who rely on traditional waterlifts, human or animal operated, are literally left high and dry. In Malerkotla district, a CGWB study concluded that annual groundwater withdrawals were about 58,000 hectare metres against a yearly recharge of only 49,000 hectare metres. The water table had declined from a depth of 12 ft to 15 ft to more than 30 ft. As a result, the Persian wheels (a traditional water lift) in this district have fallen into disuse.

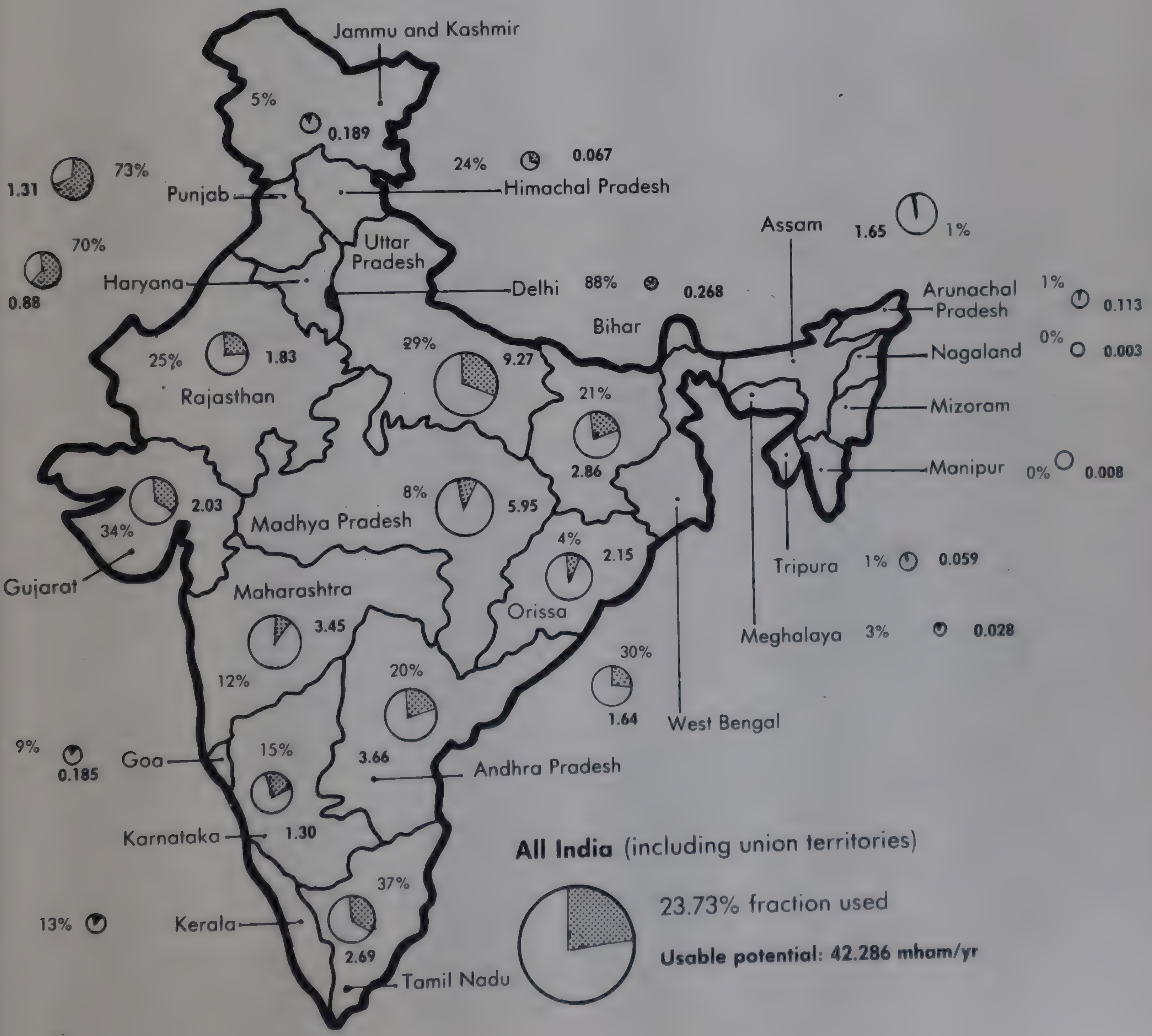
"Over-exploitation of groundwater for irrigation is an abuse," says N.D. Jayal, an adviser to the Planning Commission. In Maharashtra, withdrawals of groundwater in excess of the annual recharge for cultivation of water-intensive crops has led to a serious drinking water and food crisis. Between 1960-61 and 1980, the number of wells in the state increased by 51 per cent but the area irrigated by them doubled. This was mainly due to the spread of the use of mechanised pumpsets. The rapid depletion of groundwater has increased the number of "problem villages" with no source of drinking water from about 17,000 in 1980 to 23,000 in 1983, charges Jayal.

The shift in cultivation from rainfed coarse grains to the water-intensive sugarcane crop in Maharashtra has also led to severe local shortages of groundwater. In Manerajuee village of Tasgaon taluka, a water supply scheme for sugarcane cultivation was commissioned in November 1981 at a cost of Rs 693,000. The source went dry a year later. Three new borewells, with a total pumping capacity of 50,000 litres per day, dug in 1982 went dry by November 1983. Borewells dug in the area up to depths of 200 metres in 1984 were found to be dry. Almost 2000 privately owned wells in this area also went dry. At present water is being brought by tankers from a distance of 15 km .

Much the same thing is happening elsewhere. The Ahmedabad Municipal Corporation increased its groundwater withdrawals from 1.7 billion gallons in 1951-52, to 18.35 billion gallons in 1971-72. The city magazine 'Amdavadma' reported that in 1980, 450 tubewells withdrew 34 billion gallons to meet domestic and industrial demand.

As the magazine reported: "In the recent past, the level has been going down at a rate of 1.5 to 1.9 metres per year. But lately, a drop of 3 metres to 6 metres in a season has also been noticed in some areas like Gomtipur." Consumers who do not have access to pumps with higher lifts face

**Groundwater Potential and Use**


Jammu and Kashmir
5%
0.189
Himachal Pradesh
24%
0.067
Punjab
73%
1.31
Haryana
70%
0.88
Uttar Pradesh
29%
9.27
Delhi
88%
0.268
Rajasthan
25%
1.83
Gujarat
34%
2.03
Madhya Pradesh
8%
5.95
Bihar
21%
2.86
Orissa
4%
2.15
Maharashtra
12%
3.45
Goa
9%
0.185
Karnataka
15%
1.30
Andhra Pradesh
20%
3.66
Kerala
13%
Tamil Nadu
37%
2.69
West Bengal
30%
1.64
Assam
1.65
1%
Arunachal Pradesh
1%
0.113
Nagaland
0%
0.003
Mizoram
Manipur
0%
0.008
Tripura
1%
0.059
Meghalaya
3%
0.028
All India (including union territories)
23.73% fraction used
Usable potential: 42.286 mham/yr

increasing hardship. The Sabarmati riverbed is dry for most of the year partly because groundwater seepage into the river is almost negligible.

Overuse of groundwater can lead to the intrusion of saline water, particularly in coastal areas, making the water unfit for drinking and irrigation. In the fifties, farmers in the southern coastal plains of Saurashtra in Gujarat, began intensive cultivation of vegetables and sweet lime using groundwater. By 1970, the groundwater was affected by saline intrusion from the sea and a drop in agricultural production followed. Between 1971 and 1977, the affected area increased from 35,000 hectares to 100,000 hectares. An experts committee has recommended a reclamation plan which will cost Rs 64 crore.

The deltas of the Godavari, Krishna and Cauvery rivers on India's east coast represent important pockets of groundwater. In the past, water was drawn from shallow wells and there were return flows and proper drainage control. But in the last two decades, exploitation of these reservoirs has mushroomed with the increased emphasis on multiple cropping and high-yielding varieties. The recurring droughts in Tamil Nadu since the start of the present decade have led to the installation of a large number of deep bore-wells along the coast. This has heightened the threat of saline intrusions, particularly in the tiny coastal groundwater reservoir around Madras city (see box).

**Pollution**

Groundwater is less susceptible to pollution than surface water, but its pollution is more difficult to detect or rectify. Recent studies indicate that the problem is growing and in some parts seriously. Some of the culprits: textile printing and dyeing units in Rajasthan, tanneries in Tamil Nadu (see box) and Uttar Pradesh and the coir processing industry in Kerala.

In September 1983, the Rajasthan Assembly was rocked by noisy scenes when several newly installed tubewells and handpumps near an industrial area near Jodhpur discharged coloured water.

A report by the Jodhpur Environment Cell of the Gandhi Peace Foundation (GPF) says that about 1,500 small-scale textile units in Jodhpur, Pali and Balotra discharge 15 million litres of effluents every day into open drains, river beds, reservoirs and ditches. Because the soil is sandy, the harmful chemicals percolate into wells, tanks and reservoirs from which about a million people obtain their water. Cattle, wildlife and crops are also affected.

Research by Jodhpur University's chemistry department has identified several carcinogenic compounds in the effluents. A GPF survey identified various forms of cancer, among other diseases, in the area. The high pH of the water — more than 9 — has affected crops. The GPF report alleges that 7,000 hectares to 10,000 hectares of land has been ruined and charges that the industry which has an annual turnover of Rs 400 crore is taking no pollution control measures.

The coir processing industry in Kerala is destroying the water in much the same way. All across the state, coir units soak coconut husks in pits to remove the fleshy matrix from the fibre. In the process, groundwater is contaminated by hydrogen sulphide and organic acids. Dr C. Karunakaran, director of the Centre for Earth Sciences Studies Trivandrum thinks that the shallow acquifers could be flushed by heavy rain, but the problem of the deeper acquifers is more acute as they are the main source of water for the state in the future.

With barely a quarter of the renewable groundwater resources tapped so far, India runs the risk of polluting most of the rest, even before they are used.

### A Town goes on Strike

The North Arcot district of Tamil Nadu is the best example of how industry can ruin the environment. Untreated effluents from about 250 tanneries most of which abound in the towns of Ambur and Ranipet, have turned it into a wasteland. Crop production is down by more than 70 per cent. The water is undrinkable—the level of water conductivity, which determines the 'safeness' of water, is several hundred times the permissible limit. Respiratory and skin diseases have a field day. Even animals refuse to graze in these stinking parts.

Nearly 70 per cent of India's total exports of leather and leather products come from the 423 recognised tanneries in Tamil Nadu. There is a concentrated attack on both soil and water in Ranipet, Ambur and Vaniyambadi in the district. Of these Ambur is the worst affected. None of the firms has invested in effluent treatment equipment. The daily discharge of effluents from 41 tanneries in Vaniyambadi, studied by C.A. Sastry of IIT Madras is around 1,100 cum. Many tanneries have installed concrete storage tanks from which the effluents are evaporated. But their capacity is limited and the overflow is dumped either on fields or let into irrigation tanks and rivers. The King's Institute in Madras has declared Ambur's water supply to be unfit for human consumption. Now the factories have been given until 1985, an extra year, to start an effluent treatment system on a cooperative basis.

But the damage has already been done. Quoting a 1979 report by a soil scientist on the condition of the soil in the Vellore area, the Indian Express recently pointed out that "the effluents from the tannery industry have resulted in 10,000 acres being severely affected and another 30,000 acres being moderately affected in Vaniyambadi, Ambur, Vellore, Arcot, Wallajah, Ranipet, Visharam and Timir towns." Soil in these areas yields only about 20 tonnes of sugarcane an acre as against the normal yield of 60 tonnes. In Pernambut, 3,000 acres of prime land are being used for ragi which is believed to better withstand the effluent onslaught, but the ragi output is also falling.

What compounds the problem is that the effluents are released directly into or find their way to the Palar river and all wells on both banks and the river itself—the major source of water supply—have been severely polluted. Some 3,000 taps in Ambur now disgorge only polluted water.

There have been protests, notably on June 5, 1984—World Environment Day. The Community Action for Development (CAD), a voluntary organisation working in this district organised a hartal (strike) to persuade the state government to withdraw the extension granted to the tanneries to instal treatment facilities.

Even owners of petty shops downed their shutters. Men, women and children went in procession through the main streets of the town. Some carried pitchers containing contaminated water and broke them in front of the municipal office. Drummers led the procession (drum beating is usually associated here with funerals) and an effigy of an 'effluent monster' was burnt.

The concern is now deep and widespread. Some youths who participated in the procession even claimed that of late parents had been hesitant to give their daughters in marriage to boys living in Ambur area. Every speaker at a citizens' public meeting demanded that the pollution problem be solved immediately.

## Fibre Fight

The Harihar Polyfibres factory in Harihar town, Dharwad, produces about 165 tonnes of factory grade pulp every day, which is used by the nearby plant of the Gwalior Rayon and Silk Manufacturing Company (GRASIM) to make rayon. Both plants also produce 45,000 cum of effluents daily—and thereby hangs a stink. Despite claims that the discharge is being properly treated before it is let loose into the Tungabhadra river, the effluents are clearly a menace to the environment and to people.

The once sparkling water of the Tungabhadra, considered the elixir of the gods, is now a stinking brownish red. Frothy black liquid and pale green alkali wash travels down to the river under a smelly canopy of sulphide fumes. Gases like sulphur dioxide, carbon monoxide and hydrogen sulphide play havoc with the lungs of the villagers.

The results are obvious. Almost all the villagers downstream, are forced to use the polluted water and complain of frequent headaches and leg and back pains. Dysentery, indigestion and gas are common as are skin irritation and eruptions. The eyes turn yellow. There is also an unknown malady of the intestines which calls for costly surgical treatment, and strikes at everybody regardless of age—Nagappa Kuppelur of Harnagiri, aged 9, suffers from it.

Most villagers are dependent on the river for drinking water, bathing, irrigation, fishing and for giving water to their animals. With the river polluted, the daily collection of drinking water has become a slow, tortuous procedure. "We dig a hole on the banks of the river and with the sand acting as a filter, we collect water. It takes us almost two hours to fill one pot of water," says a villager.

Crops are as drastically affected. N.K. Patil of Harnagiri says that where he used to get 6 tonnes to 7 tonnes of jowar from one hectare, he now gets just 1.8 tonnes to 2 tonnes. Groundnut yields have dropped by 10 bags to 15 bags. One prosperous farmer says he knew the factory was the culprit because the yield went up when the factory was shut down for six months due to a strike. A Nadiralahalli farmer complained that his bulls did not live as long as they used to: "They produce phlegm, get fever and die." Santai Jandar of Nalvagal began taking her buffaloes upstream after three of them died after drinking the water. And Patil adds that "the buffaloes don't even give as much milk as they used to".

Nalvagal village immediately behind the factory is the worst-affected by air pollution. An iron pillar in the school, for instance, crumbles at touch. Even hardy trees like the neem display sickly yellow leaves.

In 1982, the chief executive of the Birla-owned factory, when questioned about the pollution, replied: "We have put up a Rs 1.2 crore treatment system and are spending Rs 30,000 a day to treat the water discharged. Why should we spend another Rs 25 lakh for covered drainage pipes?" The villagers retort that the plant never works or works only when officials visit the factory for inspection.

A factory report claims that the water is polluted by the Belludi Nala and Harihar town's sewer discharge even before the effluents get into the river. However, Prabhu Dandayatimath of the Karnataka University, Dharwad, analysed samples of effluent and river water and says that the levels of BOD and COD after the effluents meet the river go up as high as 300 and 1,200 respectively. The factory says it is improving its treatment from water of irrigation standards to water of river discharge standards. Yet there are regular incidents of mass mortality of fish. The villagers continue to eat the fish—"what can we do?"—but the fisherfolk find that the catch has decreased steeply over the years.

Over the last 10 years the villagers have made repeated attempts to organise against the pollution. In the early 70s, pressurised by the village panchayat, the public health institute tested the water. However, after submission, the report mysteriously disappeared. Leaders from seven talukas brought together the villagers and marched to the factory where they organised a hunger strike in December 1979. The factory authorities agreed to sort out matters with the MLAs. But nothing was done. The MLAs said the factory was already putting medicine in the water to make it safe and promised they would get something more done. But the local villagers allege that in every encounter with the authorities, the MLAs emerged as the beneficiaries.

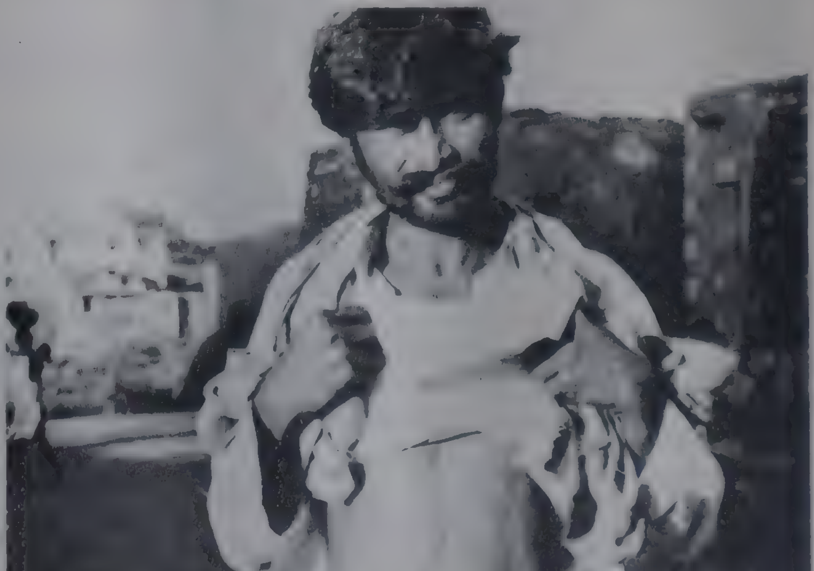
As a result of the 1979 hunger strike by Nalvagal villagers, it was decided at a meeting presided over by the chief minister that the factory would pay a lumpsum compensation for rehabilitating the village and utilise the existing land for industrial purposes.

In September 1980, Dharwad Deputy Commissioner Renuka Vishwanathan wrote to the chief secretary complaining that there was considerable delay in the implementation of the decisions taken at the December meeting. For her pains, Vishwanathan was transferred from Dharwad within the next three months.

Three organisations—the Dharwad based India Development Service (IDS), the Gandhi Vidyapeeth in Vedchhi, Gujarat and a human rights agency, Transnational Centre—recently got together and adopted a three-pronged approach to organise the villagers against the pollution. The villagers have been mobilised through camps, talks and padyatras. Study tours have been organised to similarly affected areas in Kerala and Madhya Pradesh. A 15-day orientation training programme was held in November 1983 in Gujarat for teachers and villagers from the affected region which was followed up two months later by a 12-day environment camp on the banks of the Tungabhadra and another camp on nonviolent direct action. Professional groups like Society for Clean Environment (SOCLEEN) of Bombay have been involved in analysing the effect of pollution.

In February, 1984 there was a massive fish kill. The villagers did not take this lying down and samples of the dead fish reached the relevant authorities while letters went to the chief minister. The state pollution control board ordered the factory to stop the effluent discharge and its special team of investigators found dissolved oxygen levels so low that the fish could not live. Only when the dissolved oxygen content rose to acceptable levels was the ban lifted.

By now the fisherfolk felt that they were entitled to compensation. The Harihar Polyfibres and the GRASIM plants were picketed and a delegation of villagers and three scientists spoke to factory representatives, who refused to give information on pollution and effluent treatment. As regards compensation, the delegation was invited to take recourse to the law. The fight goes on.



**A villager complains of intestinal ailments caused by polluted Tungabhadra river. (Priya Deshingkar)**

## TANKS

The technology is as old as the Ramayana. Tanks are small reservoirs built by constructing earthen dams and are among the oldest methods of irrigation through systematic storage of runoff water or water diverted from a stream. There are thousands of ancient tanks in India: one was recently discovered at Shringaverapura near Allahabad which is well over 2,000 years old. It was here that Rama began his 14-year exile, and was ferried across the Ganga by the local Nishada chief.

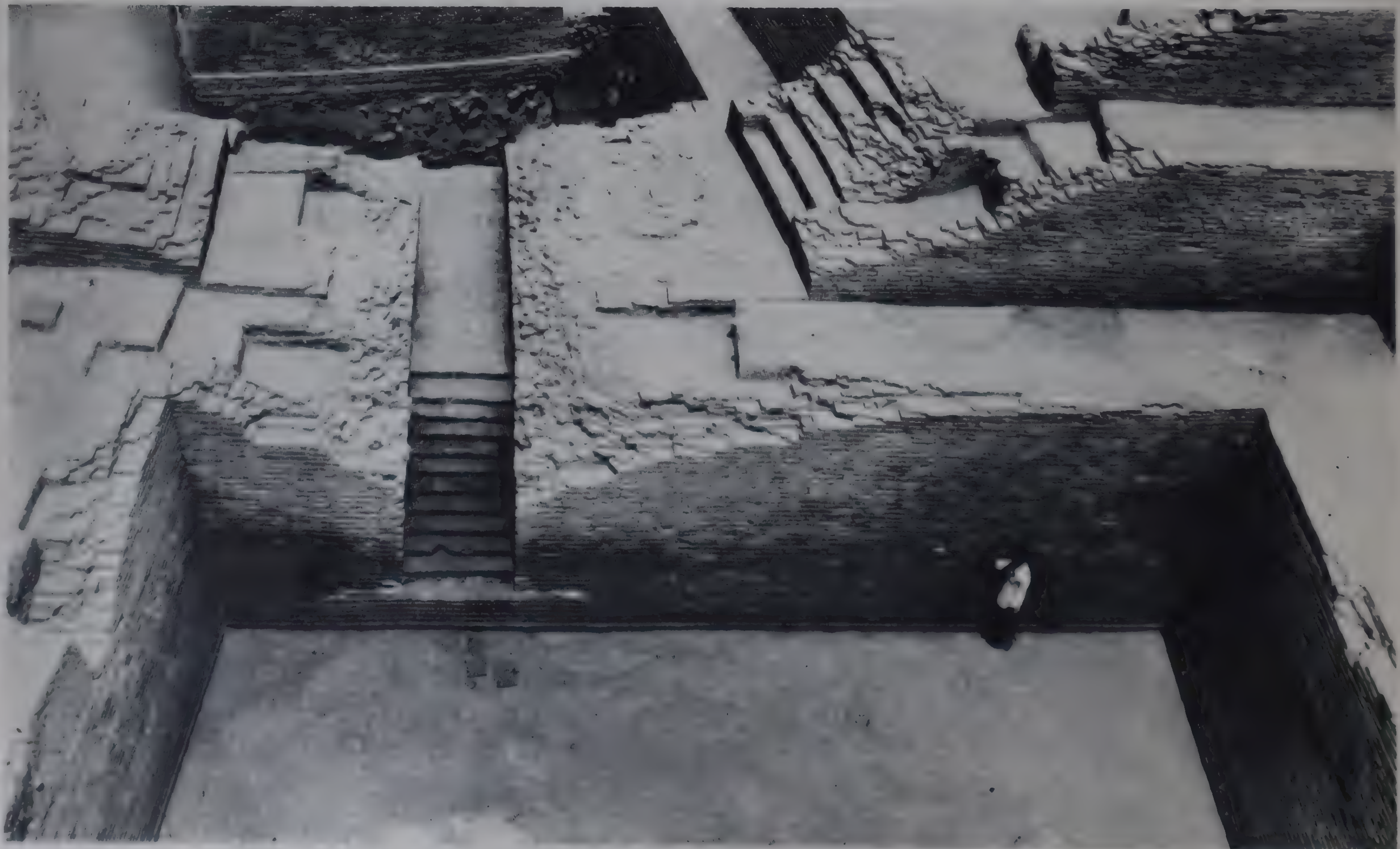
In the southern states several ancient tanks are still in use. The Pampasagar tank in Bellary district on the Tungabhadra river is probably the Pampasaras mentioned in the Ramayana. Telengana, termed a land of rice and tanks, also has many ancient tanks. The lakes of Pakhal, Ramappa, Laknavaram and Sanigaram in the districts of Warangal and Karimnagar were built in the 12th and 13th centuries by the kings of that period. There is a system of tanks at Kattagiri referred to in inscriptions of 1096 AD in which tanks are constructed in a series at different levels of a watershed.

Several British chroniclers were impressed by the extent of tank irrigation in India. An 1856 study on irrigation in southern India points out: "The extent to which the tank irrigation has been carried throughout all the irrigation region of the Madras Presidency is truly extraordinary. An imperfect record of the number of tanks in the 14 districts shows them to amount to not less than 43,000 in repair and 10,000 out of repair or 53,000 in all."

A recent study on tank irrigation by the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) at Hyderabad points out that the density of tank irrigation in India today varies considerably from district to district. In the semi-arid tropical region of India, tanks are concentrated mainly in south and central India: in the coastal districts of Tamil Nadu and Andhra Pradesh, in south-central Karnataka, in Telegana and in east Vidarbha. In north India, two pockets show a high density of tank irrigation: northeast Uttar Pradesh (in the area of the former kingdom of Awadh) and Rajasthan (east of the Aravalli mountain range).

The Indian princes were apparently far more active in constructing tanks than the British. In the old Madras Presidency, for instance, the extent of tank irrigation has not increased much since 1882-83, a period of over a century, even though the total cropped area in the region has increased about eight times. While tank irrigation covered over 50 per cent of the total cropped area a century ago, today it covers less than 10 per cent. In sharp contrast, tank construction went ahead at a hectic pace during the same period in the old Hyderabad state under the Nizams. The 4,000 ha of tank irrigated area in 1895-96, had increased to about 55,000 ha by 1905-06 and between 324,000 ha and 364,000 ha by the late 1940s. These estimates do not include private tanks.

A number of factors may have led to more tank construction by Indian princes than the British. Tank irrigation systems need a strong local authority to generate collective action for building tanks, to distribute water, and to regularly maintain them. The princes apparently had greater control over village communities than the British rulers.



**A 2000-year old tank for storing drinking water was excavated at Shringaverapura. The tank uses many modern hydrological principles. (B.B. Lal)**

But even more important, the emphasis of the British in agricultural and irrigation development was on promotion of export crops rather than on local food production. On the other hand, construction of tanks must have helped to increase crop production and population density, and thus made the rulers stronger in holding out against the territorial claims of the British.

Except for the first decade after independence, construction and maintenance of tanks has been largely neglected by the Indian government. The Famine Enquiry Commission of 1944, appointed to investigate the Bengal Famine, had strongly recommended the construction of tanks and suggested enforcement of legal measures to ensure their proper maintenance. The Grow More Food Campaign launched in 1943 and subsequently integrated with the First Five Year Plan, had also placed considerable emphasis on minor works and repair of derelict tanks. Large sums were made available as taccavi loans and grants. The proportion of tank irrigated area to the country's net irrigated area reached a peak of 21 per cent in 1958-59 but dropped steadily to 10 per cent in 1978-79. The extent of tank irrigated area also peaked between 1958-59 and 1964-65, from 4.6 million ha to 4.8 million ha but by 1978-79, had dropped to 3.9 million hectares.

Apart from the planners' obsession with large projects, there were a number of factors that led to the neglect of tanks in independent India. The availability of diesel and electricity-powered pumps increased the attraction of tubewells, especially as they could be controlled privately, compared to tanks which are a community resource. At the same time, because it was difficult to raise water rates, public agencies found it difficult to raise enough funds to maintain tanks.

**Growth of tank irrigation in post-independent India**

| | Tank irrigated area (A) | Net irrigated area-from all sources (B) | A/B (%) |
|---|---|---|---|
| 1950-51 | 3.6 | 20.9 | 17.2 |
| 1958-59 | 4.8 | 23.4 | 20.5 |
| 1970-71 | 4.5 | 31.4 | 14.3 |
| 1978-79 | 3.9 | 38.0 | 10.3 |

Source : - Indian Agriculture in Brief — 18th Edition

### Ancient Art

Nobody knows for sure if Rama did drink water from the Shringaverapura tank. But there is no doubt that, 2,700 years ago, Shringaverapura incorporated sophisticated water management skills. Excavated by Dr B.B. Lal, former director general of the Archaeological Survey of India, the tank, about 60 km upstream of Allahabad in Uttar Pradesh, dates back to the 7th century B C Excavation is not complete, but the complex already measures 200 m in length, 10 times the size of the tank discovered at Mohenjodaro.

The engineering here is far more advanced than in any other ancient river-fed tank. The engineers used the lay of the land to draw water from the Ganga through a nullah and used settling chambers before allowing the water to pass through a conduit. The water was brought in from the river during the monsoon, so the removal of silt was high on the list of priorities.

The water was brought to two deep, roughly circular chambers cut into the natural clay, where silt and other muck were allowed to settle. From the upper level of the second silting chamber—today city water supply systems use six to eight of these—relatively clean water passed through a 1.60 m inlet channel into the main tank complex, constructed entirely of kiln-fired bricks.

The mouth of the inlet channel has a stepped base and is flanked by two curved walls to break the force of the water as it rushes in. The inlet channel is also curved and becomes wider as it proceeds inwards. When the water fell into the tank complex it was made to cascade over a series of steps and at the point where it fell on the bed, brick paving was provided to guard against corrosion.

The big tank, which is going to be bigger when fully excavated, had not been dug deep enough to reach the subsoil water level. Instead, several wells were dug on its bottom to allow subsoil water to rise to the surface, ensuring adequate water supply even in the dry summer months.

## Zamindari abolition

With the abolition of the zamindari system, the responsibility of tank management, water distribution and repairs fell on public agencies, who have no funds for maintenance and repairs, which a study in Andhra Pradesh found was about one-third of one per cent of the cost of constructing a tank. "A gradual erosion of the capital of irrigation tanks is the consequence", says an ICRISAT study. In states like Tamil Nadu where tanks are traditionally community resource and where communities customarily contribute labour towards repairs, the situation is apparently a little better.

The Second Irrigation Commission listed several areas where tank irrigation has steadily declined. In Srikakulam, Visakhapatnam and Anantapur in Andhra Pradesh, the commission noted that a number of zamindari tanks have fallen into disuse because they had not been properly maintained. In Gujarat, the commission reported, out of 1,142 tanks at the end of 1964-65, only 294 tanks or 26 per cent, were in good shape; most of the others were working only partially or were derelict. A good proportion of the partially working tanks also went out of use during the 1965-66 drought. A large number of tanks fell into disuse because of siltation: the repair, maintenance and operation of these tanks had been left to panchayats.

Tanks have played an important role in irrigation in Madhya Pradesh. In 1952, they accounted for 26.4 per cent of the state's irrigated area, and even in 1968-69 this percentage was a high 13.5, though the tank irrigated area in the state fell from 235,000 hectares to 177,000 hectares in the same period. "Wherever we went in the state, there was a demand for minor irrigation schemes, arising possibly because of the delay in the execution of major and medium projects," noted the commission. "There was also a demand . . . for action to maintain and repair tanks, which exist in very large numbers, but which, through lack of maintenance and repair, are going out of use. In Bastar district, where there is little scope for big projects and where a small population is thinly spread over a large area, minor irrigation works, particularly small tanks, have the greatest utility."

The silting up of tanks, particularly the old malguzari tanks continues to be a perennial problem in Maharashtra. The area irrigated by the old malguzari tanks in Vidarbha districts declined from 157,000 hectares in 1954 to 97,000 hectares in 1960. While the government has prepared several programmes to repair and renovate the larger tanks, the smaller tanks under the zila parishads have generally been neglected and have been fast deteriorating.

Karnataka is another state where tanks have traditionally played an extremely important role. But here, too, tank irrigation has failed to keep pace with other sources. About 260,000 hectares were irrigated by tanks in 1901, accounting for over half the total irrigated area of about 504,000 hectares. By 1968-69, the irrigated area had risen to 1234,000 million hectares while the tank irrigated area rose to only 351,000 hectares.

Tamil Nadu is yet another state full of tanks: the Second Irrigation Commission estimated about 27,000, most of them neglected. "We visited some tanks in the drought-affected areas of Ramanathpuram district," noted the commission. "The Srivilliputhir taluk is badly drought-affected and it was no surprise that the tanks there were all dry." However, the commission found that the State PWD had taken on the repair of 7,500 odd ex-zamindari tanks in the district.

Many agricultural experts have begun to emphasise the importance of tanks. "Tank irrigation is basically an economically productive and profitable undertaking," argue ICRISAT experts Von Oppen and Subha Rao, who suggest the establishment of a Tank Authority of India to restore old tanks and construct new ones. Dr D.R. Bhumbla, former agriculture commissioner of India, believes that tanks are important for good water management and even a substitute for canal irrigation in medium—750 mm to 1150 mm — and high — above 1,150m — rainfall areas.

Nearly 40 per cent of the canal irrigated area in the country is in medium rainfall states. In medium rainfall areas, canal irrigation has indeed increased production of crops like rice and sugarcane but large areas have also been affected by waterlogging and production of pulses and oilseeds has fallen. The deterioration in the soil resource base is alarming.

Several dams and canal systems have also been built in high rainfall areas. About 30 per cent of the canal irrigated area of the country is in high rainfall states. More than 90 per cent of the irrigated area during the rainy season is under rice. But rice yields have not shown any improvement over the last 20 years. Meanwhile large areas have been plagued by waterlogging and salinity.

## Tank Irrigation

Dr Bhumbla argues that tank irrigation would be extremely useful in such situations. Research shows that if supplemental irrigation was available to crops from tanks, yields would increase by more than a tonne in most cases. Tanks would also be useful in reducing floods, recharging wells and providing drainage in high rainfall periods. He lists many agroclimatic situations in which tank irrigation would be enormously beneficial. In certain rice growing areas of the Chotanagpur region of Bihar, eastern Madhya Pradesh and Orissa, farmers allow 30 cm to 40 cm of water to continue to stand in July and August to tide over long dry periods. This results in reduced tillering and low yields. But if supplemental irrigation in critical periods was assured through tanks, this practise could be given up, leading to increased yields.

In the sub-mountainous areas of Jammu and Kashmir, Himachal Pradesh, Punjab and Haryana, crop failures are common even when the average rainfall is high, especially in the lower Shivaliks. At the Sukhomajri project near Chandigarh, where a small tank has been constructed, with a catchment of 9 hectares of degraded land, it has been possible to irrigate 20 hectares and farmers are now taking two to three crops. The department of agriculture in Himachal Pradesh has built 20 tanks in gully beds in Bilaspur district and these tanks have provided stability to both maize and wheat production. They have cost an average of Rs 5,000 per hectare to build.

In the deep black soil regions of Madhya Pradesh, wheat crops are often affected if the rains recede early: the surface dries up and it is not possible to sow rabi crops. Tanks could provide water for pre-sowing irrigation so that water in the soil profile can be used for growing crops. Storing water in tanks during kharif would also provide a system for drainage during the monsoon months and, as a research project at Indore has demonstrated, more crops could then be taken.

Areas of Maharashtra and Karnataka which grow sorghum in rabi would also benefit greatly from tank irrigation, as would the tribals in Udaipur district who grow maize, particularly sensitive to moisture stress in the later stages of growth. Tank irrigation could not only stabilise

### Water Harvesting

It is obvious that the first step in any rational water management policy must be soil conservation. To retain more of the water than it does at present, the ground must have vegetation on it, and for this the soil must be healthy. The best way of increasing groundwater recharge is to provide a good forest cover, with permanent grass cover coming a close second.

Collecting the water is equally important. Perhaps the most efficient and economical method of water harvesting is tanks. Dr P.R. Pisharoty of the Physical Research Laboratory in Ahmedabad says: "All places in India with 50 cm or more of annual rainfall can be taken care of by collecting the rainwater which falls in situ."

He proposes a system of 30,000 tanks, each measuring 100m x 100m x 10m — or 10 hectare-metres in volume — in each of the over 300 districts that receive more than 500 mm of rain a year. For areas with annual rainfall averaging 800 mm, a collection efficiency of 50 per cent over a catchment area 30 times the pond's size, and an annual evaporation loss of 2 metres, each pond will store water to a depth of 10 metres. In areas averaging only 200 mm of rain annually, a catchment area 50 times the size of the pond, 60 per cent collection efficiency, and 4 metres evaporation loss will give a depth of 8 metres.

The cumulative harvest of water would come to 90 mham, amounting to almost a quarter of the total annual rainfall and more than all the surface water considered usable today. The surface area of the ponds would cover almost 3 per cent of India's land area. These figures however, are the result of very rough, order of magnitude calculations. Their usefulness lies in the fact that they indicate the potential of this approach to water harvesting. A realistic scheme will require careful local surveys and detailed planning. But, as Pisharoty says ruefully, "this strategy is not fashionable enough for our planners."

In some areas, however, voluntary organisations are active. In the drought prone Baramati district of Gujarat, the Baramati Agricultural Development Trust mobilised a few hundred villagers to build a hundred dams which resulted in a rise in the water table. Bank loans helped subsistence level farmers to dig wells and purchase diesel pumpsets and pipes for irrigation. In Pune district of Maharashtra, 150 percolation tanks were constructed during the drought years.

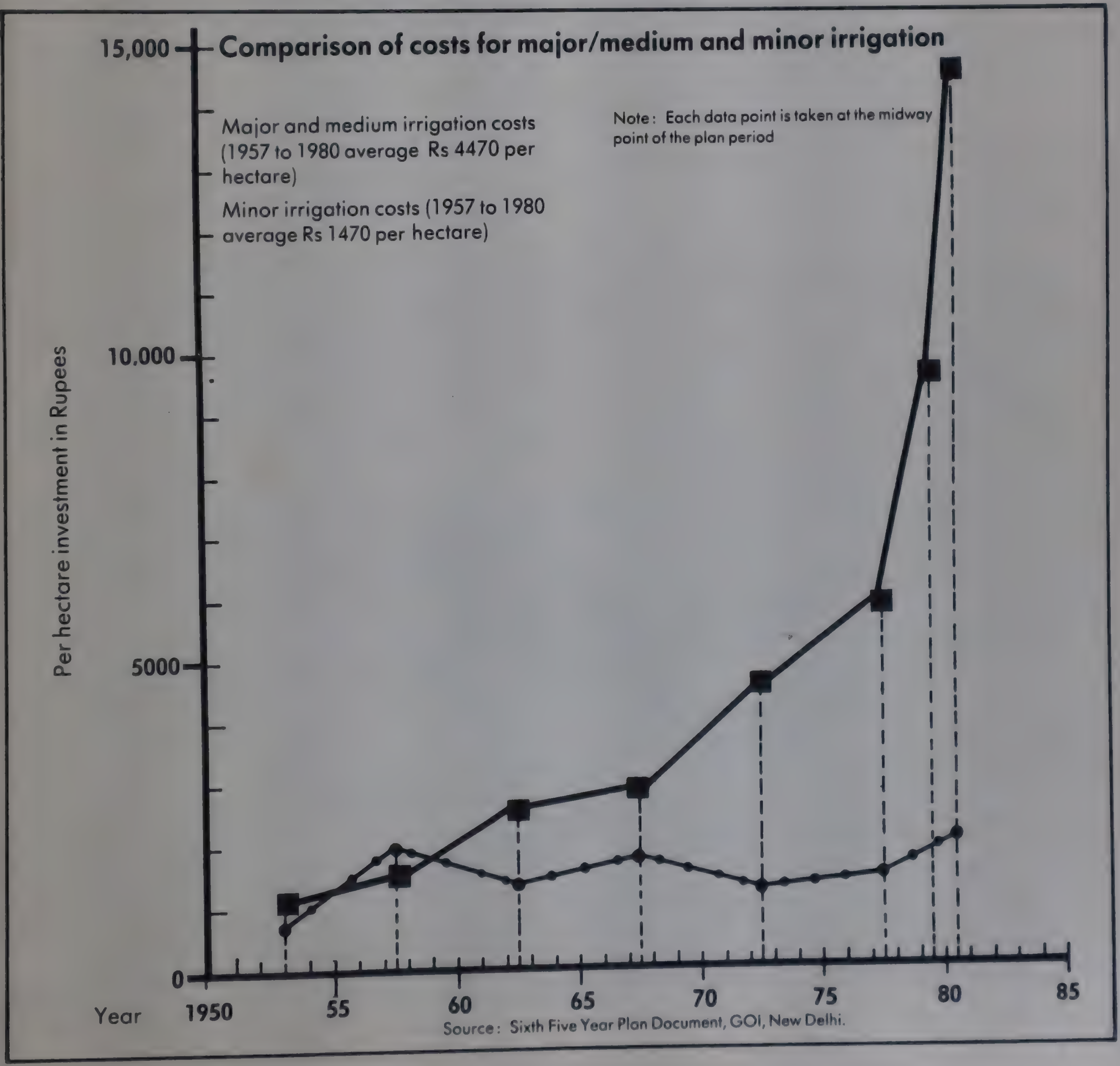
But such piecemeal efforts, laudable as they are, are simply not enough. There has to be a comprehensive water collection, management and distribution policy for all of India. Otherwise the country will stagger from crisis to crisis.

maize production but also ensure good wheat production in the following season. Groundnut production in Gujarat also fluctuates widely depending on the availability of moisture at pegging time and tanks could be easily constructed in these areas. The Central Arid Zone Research Institute in Jodhpur has shown that even in arid areas there is sufficient runoff for fruit trees like ber to be grown by harvesting water. Water harvesting is, in fact, an ancient practice in Rajasthan.

Tanks may not be the best solution in certain circumstances, especially in areas where population density is high and hence the value of the tank's land is also high. Community organisations are weak in Indian villages and the powerful encroach upon community property, which leads to lower water levels and decreased irrigation efficiencies. In such situations, it may be better to build artificial groundwater recharge structures like percolation tanks. "There is absolutely no doubt that if stress is laid on management of rainwater by storing the excess runoff, the average production of rice can be raised to 120 million tonnes and that of wheat to 70 million tonnes within the next five to 10 years," concludes Bhumbla.

Based on the Sukhomajri experience, Dr Bhumbla argues that the general principle should be that "water should be for the people rather than for the land. Every family should have equal right on the water irrespective of the size of the holding". Water users' societies ought to be formed for equitable distribution of water from the tanks and they should also be responsible for protecting the catchment area and for the distribution of produce (like grass) from the catchment area. With proper protection of the catchment area from grazing, the tank will silt up fast and protection of the catchment area will not be possible without the participation of the people.

The government has repeatedly made noises about the importance of tanks and water conservation. The Second



Source: Sixth Five Year Plan Document, GOI, New Delhi.

Irrigation Commission had also noted that "dug-wells and tanks are, by and large, the most important sources of irrigation in the drought areas ....." But little heed has been paid to these recommendations. In fact, there is even no study available on the state of tanks in India today. The problem with the government is simple: thinking about tanks means thinking about small technology and about involving people. Bureaucracies find it difficult to think of either. As a result, small community technologies, however appropriate, simply go by the wayside.

### Watered Down

A former economist of the Central Arid Zone Research Institute, N.S. Jodha has studied two villages in Rajasthan, one each in the arid Nagaur and Jodhpur districts, to find out how the system of tanks and ponds, has fallen into disuse. In most villages in western Rajasthan, animal husbandry is an important occupation and extensive areas around villages are used as grazing lands. Without an adequate number of places where animals can drink water, these lands could not be used for grazing purposes. Villagers had, therefore, dug many ponds and tanks in the grazing areas. These 'animal watering points', locally known as 'nadis' and 'tobas', were distributed across the grazing areas so that grazing pressure was spread all over. In the past, this system also ensured some degree of rotational grazing.

But Jodha found in both the villages he studied that the number of watering points had dropped to half between 1953-54 and 1972-73. The small ponds had silted up heavily and had literally disappeared. Neighbouring farmers, after proving them part of their private holdings, had begun to plough them. In the case of larger ponds, the availability of free manure and better growth of trees near watering points had strongly tempted neighbouring farmers to legally or illegally grab part of the catchments. The unoccupied area of the catchments of ponds in both villages had declined by half.

Jodha also found that the investment on the ponds' upkeep had declined substantially over the years. Before land reforms began, villagers would contribute an enormous amount of labour to the desilting and maintenance of ponds and tanks. In addition, a substantial part of the revenue earned from the auction of dung and fodder collection rights and sales of wood from around ponds and their catchments was used for the upkeep of these animal watering points. Now, however, only very limited government funds were being used for their upkeep.

As Jodha explains: "Without idealising the feudal order it may be mentioned that in the pre-land reforms period feudal authorities were able to get free labour for digging and desilting of the ponds. In the post-land reforms period, elected village panchayats could neither compel nor persuade the villagers to contribute labour for ponds. Revenues from ponds also declined because old auctioning practices were given up and not much of resources (for example, trees etc.) were left for auction or sale anyway." In this way, the contribution that the community made to the upkeep of ponds declined drastically.

In addition, since the government has started doling out large sums of money during drought periods for relief work, villagers have started expecting the government to spend the money needed to maintain community resources. Unfortunately, even when the government does give money to panchayats for such work, most of it gets siphoned off for other purposes.

**A traditional well in the arid region of Rajasthan which has been sunk in a low lying area to collect rainwater. (T. Loftas/FAO)**

## Dead Lakes

The lakes are dying. In the west, they are being killed off by acid rain. More than 50,000 small and big lakes are already dead or in their final years. In the developing world, they are in mortal danger because of eutrophication — excessive plant growth — caused by pesticides, sewage, fertiliser runoffs and open defecation.

Of the 20 well known high altitude lakes in India — lakes cover 0.2 million hectares in the country — near or above 2,000 m, only two are unaffected: Kodaikanal and Mukerti in the Nilgiris. Among other lakes for whom the bells toll are Nainital and Bheemtal in Uttar Pradesh, Dal and Wular in Kashmir, Pushkara in Rajasthan, Loktak in Manipur, Khichipiri in Sikkim and Ooty in Tamil Nadu. Almost every lake near a big city is on the list: the Ahmedabad lake, for instance, is totally eutrophied, and Hyderabad's Hussain Sagar is on the way, with recent massive fish kills.

A lake dies basically because of lack of oxygen. In a normal lake the amount of oxygen dissolved in the water varies little with depth. In a eutrophic lake, the oxygen content varies from sufficient at the surface to very low at the bottom. In many cases, as in Nainital, the bottom is anoxic, or totally without oxygen.

The sad state of affairs is best illustrated by the Dal lake. If the present state of affairs continues, the lakes (Dal and Nagin, connected to each other) will be lost within the next 80 years; what will remain will be a small area in the lakes surrounded by vegetable farms and swamps.

Dal is not a very deep lake, with a maximum depth in the Nagin basin of 6 m and a mean depth of just one metre. There is a dense weed cover, which uses up most of the energy in the system. According to Charles Elliot a professor of Development Policy and Planning in UK, who has closely studied the lake's problems, three activities in particular deserve attention: the weed collectors who provide the humus and manure for the gardens and feed for livestock from the weeds collected from the lake; the gardeners and cultivators who grow vegetables and oilseeds for the citizens of Srinagar; and the tree planters who plant willows wherever they can, especially on the fringes of the floating gardens, in order to raise a timber crop for the burgeoning willow wood industries of Pahalgam.

The creation of gardens and planting of trees on the lake fringes has contributed substantially to the reduction of the lake's surface area, from over 25 sq km in 1955 to 12 sq km today. The disturbance of weed beds has probably reduced the fish stock. The runoff from the gardens has increased the volume of nitrates and phosphates flowing into the lake waters, stimulating weed growth and making mechanical dredging and weed-cutting inevitable, if the lower layers are to be prevented from running out of oxygen. Both the number of fisherfolk and the aggregate fish catch have been declining over the last ten years. Some families also make their living by cutting reeds for weaving.

Population pressure — from both natural increase and migration — is leading to the cultivating of land further and further up the hill slopes, especially of Mahadeo and Chatchul peaks. In the case of Mahadeo, the physical limit has almost been reached. Although terracing is highly developed — especially in those areas that can draw water from the irrigation channels of the Dagwan river, which feeds Dal — it is not able to prevent, especially in the upper levels, substantial amounts of both silt and natural and artificial fertilisers from flowing into the lake.

Tourists and promoters of tourism are no less responsible for the slow but steady death of the lake. About 3 lakh tourists come to Srinagar every year. But operators of the houseboats have no scruples and waste water and sewage is discharged raw into the lake.

The hotels which ring the lake pipe all their water-borne wastes into the Gagribal basin. A dozen hotels are presently under construction, mainly at the southern end of the Gagribal basin. These new hotels represent, in aggregate, the largest sectoral investment in the urban areas of Jammu and Kashmir.

Most alarming of all is the fact that the circulation of the lake is changing, because of the rapid spread of floating gardens, the encroachment on the fringes by willow-planters and the construction of a foreshore road by the state government under the World Bank-supported Dal Development Project. The net effect is to leave significant, and probably increasing portions of the lake stagnant.

It is estimated that Rs 20 crore is needed to clean up the lake. Another thing that is needed is a sewage system so that the lake doesn't end up ~~being~~ a large city sewer. But it is likely that neither of these two things will be done and that Dal lake will continue on its way to oblivion. The state government has to be prepared to antagonise the major elites of Srinagar.

Massive fish kills are common in polluted lakes of India. Dead fish are being removed from Kankaria Lake in Ahmedabad.

## INLAND FISHERIES

Fish is important to the Indian diet. About 100 million Indians eat fish. The people of West Bengal eat the most and more and more people in states like Punjab and Madhya Pradesh are taking to fish. According to a 1974-76 study, the per capita intake of fish is a daily 1.1 gm, among the lowest in the world. Fish constitutes 2.3 per cent of protein supply and 22.4 per cent of total animal protein supply.

India's position as a fish producing nation in the world oscillates between seventh and ninth. Fishing is a major source of employment 5.38 million people, of which 3.28 million live along the coastline, with the rest on river banks, lakesides or near backwaters. Kerala accounts for 30 per cent of all fisherfolk, followed by Tamil Nadu, Andhra Pradesh and Maharashtra. According to UN figures, 0.8 per cent of India's agricultural labour finds partial employment in or supplements its income through fishing. In 1976-77, the gross value of fisheries' output was US $640 million, 0.79 per cent of the gross domestic product (GDP) and 2.09 per cent of the agricultural GDP.

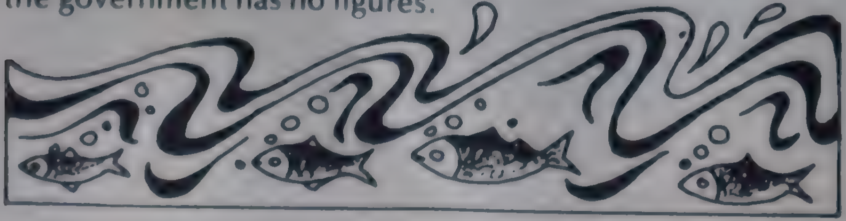
India's inland fisheries resources are among the richest in the world. The principal rivers of India, their main tributaries, the canals and irrigation systems stretch 140,000 km. Reservoirs and lakes cover 2.9 million hectares. In addition, there are about 1.6 million hectares of culturable water areas, of which only 38 per cent, or 0.6 million hectares, are currently utilised for fish culture.

**Areas of some types of standing waters in India (million hectares)**

| | 1975 | 2000 |
|---|---|---|
| Reservoir area | 2.0 | 5.0 |
| Rice fields | 38.6 | — |
| High elevation natural lakes | 0.2 | — |
| Freshwater swamps | 0.5 | — |

Source: C.H. Fernando, The fishery potential of Man-made lakes in Southeast Asia and some strategies for its optimisation, BIOTROP Aniv. Publ. 1980.

India's fish production is about 2.6 million tonnes. The demand may actually be as high as 10 million tonnes. Inland fish production increased from 0.69 million tonnes in 1971 to 0.95 million tonnes in 1981, a large part of the increase coming from aquaculture. Under the centrally-sponsored scheme for the development of aquaculture and inland fisheries being undertaken with World Bank assistance. Fish Farmers Development Agencies (FFDA) have been set up in 111 districts. Under this project, average fish production in tanks has gone up from 50 kg per hectare in 1973-74 to 582 kg per hectare in 1978-79 and 730 kg per hectare in 1981-82. But this remarkable increase masks the extremely distressing situation of riverine fisheries because of increasing river pollution and construction of dams. The riverine fish catch may actually be declining but the government has no figures.



## Riverine fisheries.

In April 1984, thousands of fish perished in the effluent-choked Gomti river near Lucknow. 'The Pioneer' a daily newspaper from Lucknow, lamented: "Every summer Gomti becomes a death bed of fish mainly because of slow flow of water and increased discharge of effluents from the neighbouring industries." In Kerala, backwater and lagoons are slowly dying because of their indiscriminate use by copra industries as dumping grounds for coconut husks.

Water pollution affects the economic lives of over 2 million inland fisherfolk. Polluted rivers carry their filth and muck even to the estuaries and the coastal areas, making their unwanted impact on estuarine and coastal fisheries. Several other factors affect fish production. Fertilisers and pesticides also play havoc with the fish population.

No river in India is safe for fish. Some 1,500 industries situated along the Ganga release untreated effluents into the river. Industries on Yamuna's banks release water at 60°C making it difficult for the fish to survive. The Kali river in Uttar Pradesh receives effluents from 24 sugar factories. At one time, 30 tonnes of fish were recorded killed along a 160 km stretch due to depletion of dissolved oxygen. Almost all Chambal tributaries, big or small, are highly polluted making Chambal's fish catch one of the lowest. Paper and pulp firms, chemical companies, sugar, cement and other industries are pouring millions of gallons of waste per day into the river Son. No fish survive up to 22 km downstream of Dehri-on-Son. The Damodar, Hooghly, Bhadra, Godavari, the Cauvery and the Kulu are no exceptions to the rule.

Next to water pollution, it is the massive dams which wreak havoc among the fish. According to V.G. Jhingran, former director of the Central Inland Fisheries Research Institute: "The river valley development programmes adversely affect both the migratory and non-migratory species of fishes. Dams, weirs and barrages act as physical barriers to migration, tending to prevent access of the fish to their usual breeding, rearing and feeding grounds. The denial of migration may result in permanent, and irrevocable reduction of fish stocks ranging from lowering the levels of abundance to complete extermination."

Damming of a river also changes the water quality in the river downstream. Quite often deep reservoirs discharge water that is low in dissolved oxygen, high in carbon dioxide and gases such as hydrogen sulphide, which can kill fish downstream. Changes in the volume of flow below the dam can increase or decrease feeding areas, affect available spawning grounds and the productive capacity of the river. Reduction in and modification of the flow downstream usually have a serious negative impact, especially on flood plain fisheries and on the productivity of coastal waters.

### Threat to the hilsas

In spite of an abundance of very fine and sharp bones as in mountain trouts, hilsa, known as Indian Salmon, has been for centuries a gourmet's delight, especially for the people of West Bengal and Bangladesh.

Hilsa skim the surface of sweet water when migrating upstream from saline estuaries. Normally the hilsa makes two runs, one known as the post-monsoon run, the major one, and other as the late winter run. In both cases the fish returns to its normal habitat, the estuary, after spawning in fresh water. The young require semi-saline water for their survival. Salmons in the West are being protected by creating special fish ladders, so that their usual "run" is not blocked. But in India barrages and dams do not have any fish ladders. This interference with their movement has severely affected their breeding.

The Ganga once used to have plenty of hilsas. Priced very high, at Rs 30 to Rs 35 a kg, two hilsas are enough to make a fisherperson's day. But the Farakka barrage near Murshidabad and the dams of the Damodar Valley Corporation have changed all that. In addition, the increasing pollution of the river Hooghly and the thin film of chemicals and oil that float on its water, partly from the Calcutta docks and partly from the industrial complex along the river is playing havoc with hilsa production.

Because of the growing scarcity there is also certain amount of overfishing, particularly of hilsas before they reach their spawning period. More than 30,000 Hooghly fisherfolk depend on the hilsa catch during the monsoon season. Already, the Farakka barrage has substantially reduced the hilsa catch, denying the fisherfolk of West Bengal almost 60 per cent of their earnings.

Nowhere is the effect of a barrage on the riverine catch better demonstrated than at Farakka. Recordings of fish catches downstream and upstream of Farakka barrage reveal that, while the hilsa catch on the downstream side was 28 per cent to 30 per cent of the total fish landings, the hilsa catch upstream, near Rajmahal, was only 1.5 per cent to 2.2 per cent of the total catch.

Even 18 years ago, hilsa was found in abundance in the upper reaches of the river — at Varanasi, Allahabad, Kanpur and up to Hardwar. Today hilsa has totally vanished from these waters. Jhingran says the total catches in the upper stretches of the Ganga at Allahabad have significantly declined from an average of 195.74 tonnes in 1958-1966 to 116.78 tonnes in 1972-76.

**Effects of Farakka barrage on Hilsa landings**

| | **Upstream of Farakka** | | **Downstream of Farakka** | |
|---|---|---|---|---|
| | Average annual landings[1] (tonnes) | % of total landings | Average annual landings[1] (tonnes) | % of total landings |
| *Hilsa ilisha* | 1.7 | 2.1 | 135.6 | 30 |
| Major carps | 35.7 | 42.9 | 91.1 | 19 |
| Total landings | 82.2 | NA | 46.1 | NA |

(1) From 1976-77 to 1978-79

Source: K.S. Bilgrami and J.S. Dutta Munshi, Limnological Survey and Impact of Human Activities on the River Ganga, Bhagalpur University.

Some experts consider the Narmada estuary to be the better of the two hilsa breeding sites in India, the other being the Sundarbans area of West Bengal. The Narmada is important not only for its fresh water and estuarine fish catches but also for the seed stocks it provides for other fresh water fisheries. Today hilsa is the most commercially exploited fish in the river after large prawns. About 4,000 families directly depend on monsoon hilsa catches for their livelihood and there are others who fish only during the hilsa season with hired boats.

The construction of the Navagam dam on the Narmada will have a major impact on the hilsas. The Sardar Sarovar will severely affect downstream fisheries, largely because of the change in fresh water flow rates, which in turn will influence the extent of sea ingress in the river. Overall fresh water supply to the downstream estuary will progressively dwindle with the development of the basin in Madhya Pradesh and increasing numbers of irrigation diversions. Government experts claim that the loss in hilsa production will be more than compensated by the production of prawns. But some experts believe that both mullet and prawns as well as hilsa will be hurt with the depleted flow of fresh water downstream and the overall change in riverine ecology.

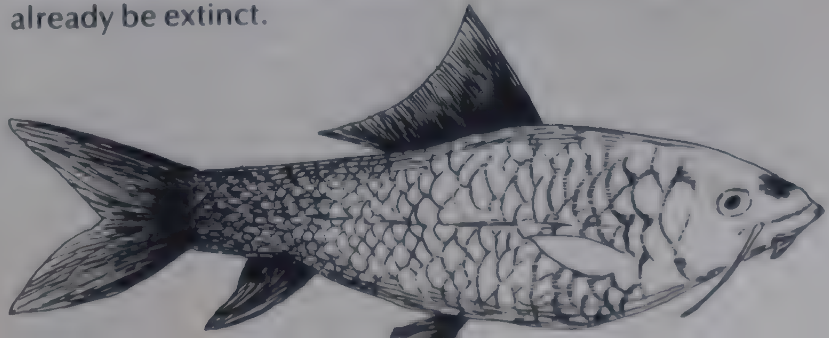
Besides the Farakka barrage, numerous other dams have effectively blocked the upstream spawning migration of hilsa. The dam at Dowlaiswaram on Godavari, 280 km upstream, has confined the hilsa to the 96 km downstream of the dam. On the river Krishna, the dam at Vijayawada has had the same effect on the migration of hilsa. With the construction of the Lower Coleroon dam the hilsa is confined to the 60 km stretch of the lower reaches of the Cauvery.

"There is an urgent need to rehabilitate and save the dwindling hilsa fishery from extinction," says Jhingran. Measures such as stocking of young hilsa and their conservation have been half-heartedly attempted. Hatching of fertilised hilsa eggs has been successfully tried in different environments. Artificial fertilisation of hilsa has also been achieved at Farakka on the Ganga. But none of these pilot experiments indicate if this migratory fish can survive without its migratory habits, floodwater forage and estuarine environment.

### Mahseer

Mahseer is another threatened fish. Known in north India as 'Raja', it is regarded as sacred by many Hindus. Mahseer is mostly found in the streams and rivers of the Himalayas. There are seven types of mahseers and they grow up to a length of 2.75 metres. In the upper reaches of the Ganga they can be as heavy as 10 kg. The fish was introduced into the lakes of the Kumaon hills in 1858, Bhimtal, Nakuchiatal, Sattal and Nainital, and flourished in all lakes except Bhimtal.

Once the swiftflowing Ganga near Rishikesh and Hardwar used to be full of them, but no longer. Their numbers in the Kumaon lakes have declined, because of indiscriminate fishing and the general and human-enforced degeneration of the lakes. The famous golden mahseer has disappeared totally from the Banar stream of Himachal Pradesh: it constituted about 40 per cent of all fish catches from the river in 1964. An appeal to the Prime Minister has at least been able to produce a government notification that mahseer should be protected from total extinction. But, there is a growing fear that one or two varieties might already be extinct.



## Fishy Story

Binaga is a small fishing village on the Karnataka coast near Karwar town. For the last 10 years the landless fisherfolk of Binaga have had to contend with one of the largest ecological menaces today: irresponsible industry.

The culprit is the caustic soda factory of the Ballarpur Industries, commissioned in June 1975. The Karnataka State Board for Prevention and Control of Water Pollution had allowed the factory to discharge effluents temporarily into the nullah near Karwar. Exactly three days after the plant was commissioned, nearly half a ton of dead fish floated down the nullah to the sea. Nearly 17,000 Rampani fisherfolk were affected along a coastal stretch of 10 km.

Despite a big protest procession and a hunger strike, a quarter ton of fish died again in August. The Committee on Government Assurances came calling in September, meeting the fishing community, visiting the factory, and the spot where pits had been dug to contain the effluents. The factory's officials admitted that it was possible that the effluents collected in the pits had found their way into the nullah. The fishing community alleged, and this was later confirmed by the Central Marine Fisheries Research Institute, that the August fish kill had come about because effluents had been surreptitiously diverted from the pits into the nullah.

That was not all. The committee also found a controversy over whether too much mercury was being discharged into the water. The factory managers maintained that the toxic contents of the effluents were within tolerable limits. But the National Environmental Engineering Research Institute felt that measures taken for reducing mercury discharge were not satisfactory and the factory later set up a mercury treatment plant.

The government finally took notice by giving some fisherfolk loans to buy deep-sea fishing boats and by asking the company to instal long pipes to carry the effluents to the sea. This hasn't helped because the state pollution control board recently found that the submarine pipe, which runs 3,800 metre out into the sea, was damaged beyond 800 metre during the 1983 monsoon. The board was still trying to get the factory to repair the pipe. Meanwhile, the organised protests of the first two years have died down, because the leaders were reportedly bribed with jobs. But the fish continue to die and many people have been forced to go out of the area in search of work.

## Waste and Wetlands

Swamps, or wetlands as they are now defined, are important for a balanced ecosystem. The earlier prejudice against swamps as breeders of mosquitoes, insects, snakes and disease persists but ecologists argue that wetlands should be protected from wanton destruction and land filling. India is perhaps losing her wetlands faster than any other country because of population pressure and lack of government control on land speculators who are using up the wetlands. West Bengal is affected most as it is ideal for wetlands — flat, deltaic, a high water table and fast silting riverbeds. Undivided Bengal — including what is now Bangladesh — had more than 200 big wetlands; some of those like the ones at Rajshahi and Mymensing in Bangladesh were 10 times the size of Calcutta's Salt Lake.

A glaring example of thoughtless destruction of wetlands is the growth of Salt Lake City on the biggest swamp near the eastern fringe of Calcutta. Already around 4,000 hectares of this fishing swamp have been filled up, leading to what a Calcutta hydrologist has called "a drainage chaos". The swamp used to receive the excess rainwater from the city. But as it is now at a higher level than the old city, waterlogging in the entire eastern fringe, with even a small shower, has become a permanent feature.

When the late chief minister of West Bengal, B.C. Roy, authorised a Yugoslav firm to sandfill around 4,000 hectares of wetlands on the eastern fringe of the city, everyone lauded the engineering feat: pumping sand from the bottom of the Hooghly and piping it to the landfilling sites. The project had two aims: remove silt and save the river, provide housing plots to Calcutta's middle-income groups.

But the Salt Lake City, which when complete will support 100,000 families, has totally disrupted the hydrological and ecological processes of the area. First, it interfered with the normal drainage cycle of the city. Second, Calcuttans, who are primarily fish eaters, were denied fish to the tune of 25,000 tonnes a year. The fisheries, destroyed by the growth of Salt Lake City, used sewage for nourishment. Since the growth of Salt Lake City, fish prices have gone up 700 per cent to 800 per cent.

But the government has not learnt its lesson. The housing and development lobby is ready to start a landfilling programme in the remaining 4,000 hectares of swamp. The Government of West Bengal is facing strong opposition from its own departments of fisheries and environment, which feel that the destruction of the only major wetland around the city will have a far-reaching environmental impact. The fisheries department argues that wetlands fisheries beyond Calcutta's eastern boundary can sustain more than 20,000 fishfarm workers in the non-urban fringes and provide more than 10 tonnes of fish per hectare with scientific management. These swamps can treat all of Calcutta city's sewage by acting as large oxidation ponds.

The sewage-fed fish ponds to the east of Calcutta are one of the few places outside China where human waste is recycled into fish on a large scale. Part of the raw sewage from Calcutta is used as fertiliser in about 2,500 ha of fish ponds. When the sewage fisheries were started in 1930, they sprawled over 10,000 ha but suffered enormously from encroachments. Farmers claim that they get annual yields ranging from 10 tonnes to 20 tonnes per hectare. One sewage farm has even reported a yield of 28 tonnes. But the people of Calcutta are by and large unaware of the 50-year-old enterprise, and unaware too of the danger that threatens it.

Chitrabani

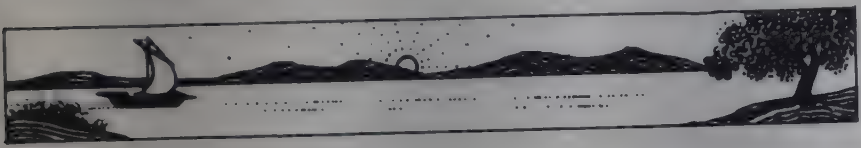
## Lacustrine fisheries

Lakes, swamps and human-made reservoirs cover vast areas in India: lakes about 0.20 million hectares, swamps and wetlands 0.5 million hectares, and human-made reserviors, about a million hectares. Most large human-made reservoirs are less than 50 years old. Reservoir fish culture is of even more recent origin, and knowledge of reservoir fisheries is extremely limited.

**Annual yields of fish in selected human made reservoirs**

| Name of Reservoir | Water spread area (ha) | Catch (1976-77) (kg/ha) |
|---|---|---|
| Bhavanisagar (Tamil Nadu) | 3695 | 79.59 |
| Nagarjunasagar (Andhra Pradesh) | 18429 | 6.00 |
| Rihand (Uttar Pradesh) | 30148 | 2.26 |
| Govindsagar (Punjab) | — | 49.7 |
| Ukai (Gujarat) | 36523 | 5.59 |
| Kangsabati (West Bengal) | 8160 | 0.89 |

Source: V.G. Jhingran, Fish and Fisheries of India, Hindustan Publishing Corporation, New Delhi, 1983.



Commercial fishing has been encouraged only in a few reservoirs and mostly exotic varieties are stocked. The Hirakud reservoir in Orissa, Maithon and Mayurakshi in West Bengal, Nagarjunasagar in Andhra Pradesh and a few others are known for their fish production. But there are few systematic studies of fish behaviour in these reservoirs, the effect of the lean summer season or the monsoon, of siltation, gradual deforestation and pollution caused by human activity in the higher reaches of the river.

Experts and biologists are in total agreement that indigenous fish will provide only low and at best moderate fish yields in reservoirs. The highest annual yield from any Indian reservoir, 190 kg per hectare, was recorded from Amaravathy reservoir, of exotic *Tilapia mossambica*. It is difficult to determine how far the depth, absence of normal waterflow, lack of foliage around most of the reservoirs, gradual siltation and population growth above the dam are responsible for the low yields. In the one million hectares of deep reservoirs in south and central India, the yield varies between 20 kg and 40 kg per hectare against 8,000 kg per hectare from fish ponds in Calcutta and 5,600 kg per hectare from semi-eutrophied fort moats in southern India.

Pollution leads to the growth and spread of aquatic plants which interfere with fish production. Fertilizer runoffs to reservoirs enrich aquatic plants a problem compounded by human and agri-waste runoffs. Aquatic plants increase water loss by transpiration, reducing the production capacity of the water impounded, and are excellent breeding grounds for many disease spreading insects and snails.

In some cases fisheries are more important financially to a reservoir than hydroelectricity. The Ubolratana reservoir in north east Thailand produces electricity worth US$ 1 million—and fish worth $ 1.2 million. The Maithon and Tilaiya dams of the DVC complex have a reservoir area of 11,000 sq km. A kilogramme of fish now costs Rs 20 in the wholesale market, and even if the fish yield was one kg per hectare, the annual earnings from fisheries alone could be Rs 2.2 crore.

The worst impact that dams can have on fisheries is to cut into fish genetic resources. Soviet Union, once a producer of the best caviar, now imports it from Iran. Dams on Soviet rivers have interfered with the migration of salmon and destroyed their spawning grounds. India has 400 known species of fresh water fish and these genetic riches need to be protected.

### Social implications

But even if reservoir fisheries were successful, and together with aquaculture were to replace riverine fisheries, this would have serious social implications. Fish production in India has been increasing largely because of the increase in aquaculture production, but this means that poor fisherfolk, who depend on free access to common water bodies like rivers and natural lakes for their fish catch, are being thrown out of jobs while richer fisherfolk who own land and financial resources are moving into aquaculture and the business of fish production.

According to Anil Prakash of the Ganga Mukti Andolan, which works with the riverine fisherfolk of Bhagalpur district, the fisherfolk have been reduced to nomadism in search of scarce fish. They blame the reduced flow in the river, increasing pollution and the construction of the Farakka barrage. They now travel as far as the Himalayas in the north and Gujarat in the west for survival and stay home for only three months a year.

Claims of employment for fisherfolk in the human-made reservoirs are not very credible: because reservoir fisheries have yet to be fully developed, and because reservoir fisheries are controlled by bureaucracies which do not involve the poor fisherfolk. It is hardly ever mentioned that reservoirs are situated at places and heights where few fishing families live. Rajasthani fisherfolk, for instance, have turned into domestic servants with the construction of dams while fisherfolk from UP have migrated to Rajasthan for reservoir fishing. Although a few fisherfolk have settled around the Tungabhadra reservoir—about 125 instead of the 400 required for the exploitation of the reservoir—the situation is still far from the ideal conditions needed for the development of a commercial fishery. In some cases, the government has started auctioning the reservoir fish-harvesting to commercial contractors. Equally alarming for poor, displaced riverine fisherfolk is the concept of aquaculture fisheries, usually controlled by rich groups who can hire experts.

Fish production in Indian rivers and lakes is, thus, riddled with problems. Pollution and dams have lowered catches to alarming levels, while reservoir fisheries are still not so advanced as to complete the loss. Then there is the very real health hazard associated with aquaculture and river-fed fisheries, with bacteria allowed to go straight into fish ponds and from there into the human system. Last but not the least, there are the environmental refugees, the fisherfolk who have been shunted out of their jobs and will no doubt crowd the already overburdened cities for employment and sustenance. To all these problems, there are as yet no answers forthcoming.

## Ganga Fisherfolk : Between Ancient Oppression and Modern Destruction

The holy Ganga, flowing past the town of Bhagalpur in Bihar, ceases to be public property. Two individual families claim hereditary rights, 'panidari', to an 80 km stretch of the river. They levy taxes on 40,000 poor fisherfolk living in 60 villages of Bhagalpur district, which amount to Rs 30 million to Rs 40 million every year. One 'panidar' claims that his rights were granted to him by a medieval Mughal king. The other claims them in the name of Hindu gods and poses as the protector of their property. The fisherfolk themselves are convinced that they are cursed and they deserve their fate: their mythology tells them that they were born from the ribs of a dead monster.

In 1964, the Patna High Court decreed that the zamindari abolition laws do not include 'panidari'. The state government appealed eight years later and the case now gathers dust in the Supreme Court. Meanwhile, the fisherfolk continue to pay and at the slightest sign of rebellion the waterlords capture their boats and nets or have them beaten up.

In April 1982, after some fisherfolk were falsely accused of murder by the waterlords, members of the Chhatra Yuvak Sangarsh Vahini, a youth organisation founded by Jayaprakash Narayan, moved into Kahalgoan, a riverine village in Bhagalpur district, to take up their cause. They organised a Jal Shramik Sangh in which every fisherman of Kahalgoan was enrolled.

The vahini volunteers soon realised that their first task was to create confidence within these poor people and help them to get over their age-old belief that they are cursed. Talking to these people also revealed that they faced multi-dimensional problems in their daily effort to survive. Whereas the traditional culture was only oppressive, the incoming modern culture was also destroying the very resources on which these people subsist. The fisherfolk complained of rapidly decreasing fish catches because of increasing pollution. The vahini workers were forced to include environmental problems also in their programme. A report by professors K.S. Bilgrami and J.S. Datta Munshi of Bhagalpur University confirms that the 112-kilometre stretch of the river from Barauni to Bhagalpur is very polluted. Industrial effluents are dumped into the river by a shoe factory owned by shoe manufacturers Bata, a McDowell distillery, an oil refinery, a thermal power station and a fertilizer factory upstream of Bhagalpur.

Fish survive only 48 hours in the water at the point where the Bata shoe factory dumps its wastes and only five hours at the distillery's mixing zone. The wastes discharged from the oil refinery near Monghyr are so large that in 1968 the Ganga is reported to have caught fire. The polluted zone at Barauni acts as a barrier to upstream movement of fish and affects their spawning. The township of Bhagalpur and nearby industries contribute to the pollution: domestic sewage, industrial effluents, and the runoff of fertilizers and pesticides from agricultural fields. All this has drastically affected the fish catch and the livelihood of the poor fisherfolk.

The Farakka barrage has also led to a depletion of fish stock as it prevents the migration of popular fish like hilsa to the foothills of the Himalayas, where it breeds. The vahini activists are also actively campaigning against the thermal power station to be built near Kahalgoan, just 40 km away from the Ganga.

The people of Kahalgoan have to contend with other environmental problems. Deforestation and the consequent erosion in the catchment areas of the river has meant increased siltation and floods. In the last 10 years, 30 m to 40 m of the river bank has been swept away, along with several houses and many lives. Three years ago, the Bihar government sanctioned Rs 51.4 lakh for the construction of an embankment along the village. This entire sum has been lost in squabbles between local politicians and irrigation officials. In February, 1983, the vahini volunteers organised demonstrations, road blocks and meetings to draw the attention of the government to the money being squandered and the problems of soil erosion. The movement has grown from a Jal Shramik Sangh to a broader-based Ganga Mukti Andolan that questions the very pattern of development in the region.

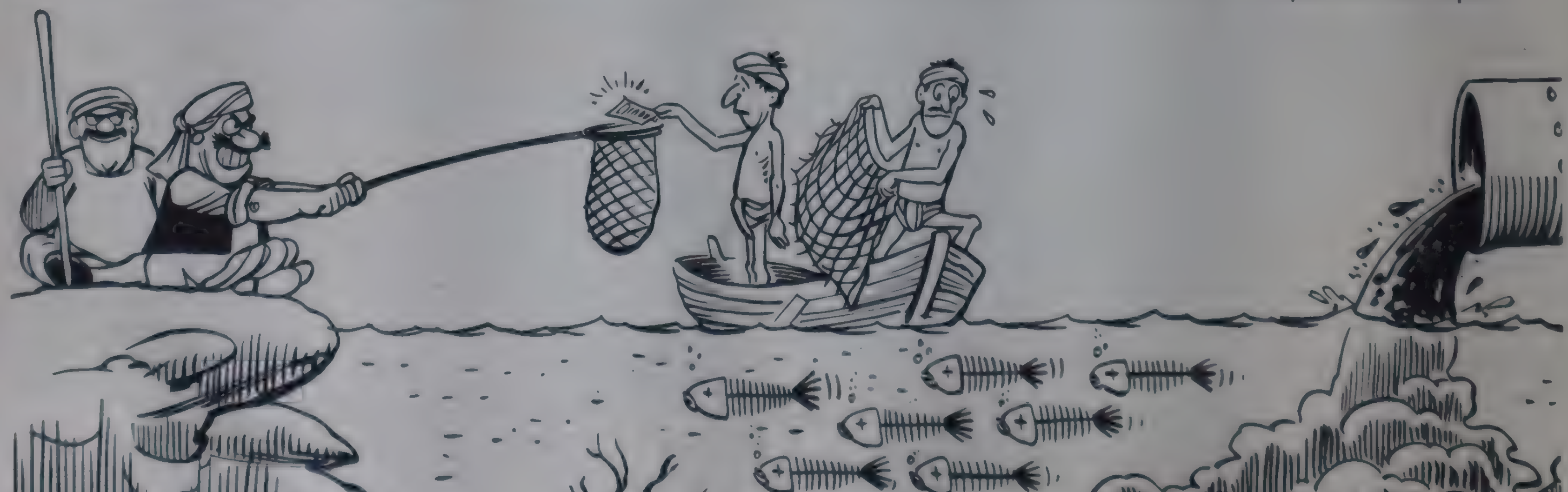
The Ganga Mukti Andolan's methods of protest are unique and colourful. In early 1983, it organised a boat procession in which 80 small and big boats decorated with banners participated. From Kahalgoan, they sailed singing songs and gathering crowds along the river bank, to a public meeting in Adampur village.

In May, 1983, the andolan organised a mela (fair) called "the Eklavya mela". The name of the mela was deliberately chosen because it has a symbolic meaning. Eklavya is a character in Mahabharata, who is denied education by the great archer, Drona because of his low caste. Inspite of this, Eklavya considered Drona his teacher and with Drona's statue as his inspiration, he diligently practiced archery till he surpassed Drona's pupils in this art. Drona was enraged and to eliminate competition, he demanded from Eklavya his thums as the traditional teacher's fee 'gurudakshina'.

The handbills and posters distributed by the Ganga Mukti Andolan at the mela question this blind obedience of Eklavya. According to the andolan, Eklavya's behaviour is blind servility to power and not very different from the fisherfolk's acceptance of their fate.

The melas increase awareness about pollution, diseases, depletion of fish and many other environmental problems. The vahini volunteers enact plays, and organise folk dances, songs, puppet shows, poetry competitions, exhibitions and public discussions.

The andolan is thus an excellent example of the emerging popular environmental movements in India. Social workers working in rural areas, soon realise that the livelihood of poor rural people depends on the rational utilisation of natural resources, which in most cases are being expropriated and degraded by the more powerful groups in society. Social upliftment, economic change and environmental protection have, thus, become interrelated and inseparable concepts.



## Murky Waters

The river Ganga is polluted at several points along its course, but the problem is very severe in Varanasi. The 7 km curve where 6 million devotees bathe every year is contaminated by incredible amounts of biological and chemical filth. Today with tradition threatened, government and local citizen organisations are stirring themselves to purify the Ganga and clean the city of Varanasi.

In Varanasi as many as six major drains and 61 small drains daily dump nearly 60 million litres of untreated sewage into the river, much of it right next to the main bathing areas. About 40 thousand human bodies are burnt at two cremation ghats and their ash dumped into the river — with the cost of wood prohibitively high, about 10,000 half-burnt bodies are pushed into the river every year. Furthermore, in accordance with tradition, unburnt bodies of saints, lepers and animals are thrown into the river — an estimated 60,000 carcasses of cows, dogs and buffaloes are dumped annually into the Ganga at Varanasi.

The pumping station which draws water from the river for the city's drinking water is situated just downstream of the largest drain of Varanasi — the Assi — and citizens have often found decomposed bodies floating near the pumps. Also, an industrial estate located upstream of Varanasi city spews waste from coal yards, a paper mill, insecticide firms and glass works.

A recent survey of the Ganga basin by the Central Board for the Prevention and Control of Water Pollution (CBPCWP) identifies the Varanasi stretch as a "heavily polluted area", where the biological oxygen demand (BOD) reaches an alarming count of 9.7 milligram per litre (mg/l) during the month of May against the acceptable 3 mg/1. At Dashashwamedh ghat, the largest in the city, the post monsoon and summer counts of BOD are around of 6 mg/l. A survey of the water has found countless cholera, dysentery and typhoid germs. Dr B.S. Mehta, former president of the Indian Medical Association, Varanasi, says that 98 per cent of the city's residents suffer from some stomach ailment or the other. "Ganga in Varanasi is nothing but a modern sewer", he says.

In the last two years, there have been a number of disconnected efforts by voluntary organisations to clean the river. These groups have however found that they have foundered because of corruption, vested interests and public apathy. The six pumping stations built 10 years ago to intercept the sewage before it reaches the river have not worked till date. The state government has now sanctioned a Rs one crore project for their recommissioning. Efforts to instal an electric crematorium are being thwarted by 'Dom Raja' owner of the cremation grounds, who stands to lose a daily income of about Rs 10,000.

The first group which geared up to combat the problem was the 'Swatcha Ganga Abhiyan' (Clean Ganga Campaign) led by Veer Bhadra Misra, the head priest of a local temple and a civil engineer by profession. The campaign hopes to spur the people of Varanasi into cleaning the river. Their education programme includes 'public awakening fortnights', when through posters, hand bills and public meetings they spread their message. They also plan an information centre in a boat on the river, a slide programme and a documentary film. A US-based fund, Friends of the Ganga, provides the campaign with technical assistance, money and publicity. But some Varanasi residents are not so happy about foreign involvement. "This is our battle," says Dr Mehta. "The problems of negligence and corruption cannot be solved by outsiders." Today another group, the Shudh Ganga Abhiyan (Pure Ganga Campaign), has been formed. This group combines work on public education with activities to pressurise the local administration to take action.

More recently, the Indian National Trust for Art and Cultural Heritage (INTACH) has entered the fray. The organisation has decided to place emphasis on schemes and projects already sanctioned, but virtually abandoned. At the instance of INTACH, the state government in June 1984 set up the Varanasi Environmental Implementation Committee with the chief secretary of the state as chairperson. The committee consists of senior state officers and the director of INTACH's Project Ganga. Work has been stepped up on the electric crematorium and the recommissioning of the pumping stations.

INTACH has found that, as the pumps were designed almost 20 years ago, they should be augmented and is exploring the possibility of a number of small sewage treatment plants all over the city, instead of the Rs 80 crore single integrated sewage transport and disposal system.

It remains to be seen if these devotees of the Ganga can save her from the furies of our times.

**With prices of fuelwood prohibitively high, over 10,000 half-burnt bodies are pushed into the holy Ganga every year. (The Patriot)**

# FORESTS

*The latest satellite data confirm that India is losing 1.3 million hectare of forests a year, nearly eight times the annual rate put out by forest departments.*

*In the five years of the sixth plan (1980-85), India will have spent over 40 per cent more on forestry than what it spent in the previous 30 years. But the increased annual plantation rate of 0.4 million hectares targeted for the sixth plan still means a million hectares of forests lost every year.*

*So great is the wood shortage and so high are wood prices that Tamil Nadu fisherfolk find it difficult to make catamarans, Karnataka villagers to buy new bullock carts and Andhra Pradesh craftspeople to make wood toys.*

*Nine dams are to be built along the Indravati in Bastar, India's last tribal frontier turning the tribals refugees in their own homeland. Bastars' forests are also threatened with mines and wood based industries.*

*By 1990, India hopes to green nearly 2 million hectares at a cost of about Rs 600 crore.*

*But the social forestry programmes are heavily criticised: trees are planted as commercial investment and not to fulfil basic survival needs of fuel and fodder.*

*They are, however, popular with farmers: in Uttar Pradesh, farmers picked up 30 times more seedlings than the target. But community woodlots, to meet the fuel and fodder needs of the poor and landless, reached only about a tenth of the target.*

*Social forestry may even be exacerbating the energy crisis for landless labourers. When 4 farmers in Punjab switch from cotton to eucalyptus, workers lost their main fuel: cotton stalks.*

*Eucalyptus covers nearly half a million hectares, but the tree is not very popular with environmentalists. In Karnataka, protesters have uprooted eucalyptus in several places, while some farmers have dug trenches between their fields and eucalyptus stands to keep eucalyptus roots away from their crops. Quick-growing eucalyptus plantations are depleting soil nutrients in Uttar Pradesh, Punjab and Haryana.*

*The government plans to give away large portions of its own degraded forest lands to the wood-based industry, a policy strongly opposed by politicians in many states.*

*Few attempts are being made to involve the landless in afforestation. Some 5 million to 10 million landless families could be settled on these lands, making it the country's largest land reforms programme.*

Of all the environmental problems facing the country, the problem of deforestation has received the maximum public attention. Ironically, no set of government policies in the field of environment has attracted greater public criticism than the policies for afforestation.

Social forestry programmes have been launched by several states to promote afforestation on essentially non-forest lands, that is, on private farms and on village commons. Several state governments have stepped up their own afforestation efforts and are also planning (in most cases, without much public discussion) to hand over large tracts of degraded government forest lands to industrial firms for afforestation.

All these programmes have one thing in common: the planting of trees to meet the needs of urban and industrial markets while the glaring fuel and fodder crises facing the common person continue to grow. The species chosen — like eucalyptus, teak and pine — also do little for ecological restoration, for enhancing soil fertility or for soil and water conservation.

The very same process of commercialising the forest resource base that has led to widespread deforestation in the country, is today the motive force behind the government's afforestation programmes being carried out with the full support of foreign aid agencies. India's afforestation is, thus, as anti-people as is its deforestation. Rural women, for instance, whose lives revolve around the collection of fuel and fodder, have almost nowhere been involved in these programmes.

People are responding with greater alacrity to voluntary afforestation efforts aimed primarily at meeting people's needs of fuel, fodder and small timber — and popular protests grow against both government sponsored deforestation and afforestation. For instance in Karnataka, while the Appiko movement is mobilising people to hug trees from being cut, the states powerful Ryot Sangha (Farmers' Association) threatens to uproot millions of eucalyptus seedlings already planted. Few in the government have the imagination to realise that afforestation of India's degraded public lands could form the core of India's largest land reforms, anti-poverty and employment generation programmes.

The following chapter consists of four sections, three of which deal with government afforestation programmes: the social forestry programmes, the nationwide debate on eucalyptus and the plans for the afforestation of the country's forest lands. The last section presents a special report on the state of the forests in Bastar, a major tribal area of the country.

# SOCIAL FORESTRY

Social forestry is a term used by the National Commission on Agriculture in 1976 to denote tree-raising programmes to supply firewood, fodder, small timber and minor forest produce to rural populations. Nearly a decade later, it is emerging as the most controversial initiative of the Indian government.

"I have seen many programmes launched in the name of the poor but soon distorted to benefit the upper classes. But no programme has been diverted further away from its objective than social forestry," T.L. Sankar, former member-secretary of the Planning Commission's Working Group on Energy Policy, told a recent meeting on cooking energy held in New Delhi. "The forest departments never seem to ask the question: wood production for whom or for what?"

Critics of the programme strongly contend that the wood produced from social forestry programmes is ending up in urban and industrial India instead of the poor in rural India, reducing rural employment and land under food production, and promoting absentee landlordism.

On the other hand, the government proclaims that a new green revolution is in the offing. Against Rs 483.22 crore of investment during the 30 years of planned development between 1950 and 1980, the Sixth Plan (1980-85) has provided an outlay of Rs 692.49 crore for forestry. A national 'umbrella' project has been prepared by the Agriculture Ministry in 1983-84 to extend social forestry programmes to all parts of the country. The Union government and the World Bank are discussing a $ 600 million proposal for a nationwide social forestry programme which will cover 13 states including a number of those in the Northeast.

Ambitious social forestry programmes have already been launched by several state governments, most of which have been financed by foreign aid agencies like the World Bank, US Agency for International Development (USAID), Canadian International Development Agency (CIDA) and the Swedish International Development Authority (SIDA). Forest departments in most states have set up separate social forestry wings.

In its annual report for 1983-84, the Union Agriculture Ministry proudly claims that in 1982-83 social forestry achieved "spectacular progress" and all targets were exceeded. In 1983-84, the momentum was even greater. The report reads: "The year 1983-84 witnessed an unparalleled enthusiasm among the people for tree planting, as could be seen from the offtake of seedlings supplied for farm forestry." Since 1980-81, over 1,000 crore seedlings have been distributed to farmers for farm forestry and planted for afforestation and, in addition, some 1.2 million hectares have been planted under social forestry programmes. By the end of 1988, the newly created social forestry wings hope to bring some 1.93 million hectares under social forestry plantations with a government investment of about Rs 600 crore.

## Growing criticism

Despite these achievements, present and projected, doubts and criticism about the actual benefits of social forestry have grown into a shrill chorus. These were first sparked off by a study in Kolar district in Karnataka which showed that it was nothing but a masquerade for tree farming, encouraged and supported by pulp and rayon mills hungry for pulpwood. And as a result of which extensive

Planting of trees along roads is a major component of social forestry. But it has proved expensive and few trees survive.(UNEP) food growing lands were being replaced by eucalyptus plantations.

Social forestry programmes have mainly three components: farm forestry, encouraging farmers to plant trees on their own farms by distributing free or subsidised seedlings; woodlots planted by the forest departments for the needs of the community, especially along roadside, canal banks and other such public lands; and community woodlots planted by the communities themselves on community lands, to be shared equally by them.

Judging by the World Bank's own mid-term reviews of social forestry projects in Uttar Pradesh and Gujarat, big farmers are emerging as the primary beneficiaries. In Uttar Pradesh, the World Bank assisted social forestry programme overshot its farm forestry target by 3,430 per cent, a phenomenal and unprecedented degree of success for a government programme. However, efforts in the creation of community self-help woodlots achieved only 11 per cent of the target, a disastrous record even though this component of social forestry programmes is aimed most at meeting the needs of the neediest in the rural communities, the landless and small and marginal farmers. In Gujarat, too, farm forestry targets were exceeded by more than 200 per cent whereas community self-help woodlots met only 43 per cent of the target.

In communist-ruled West Bengal, the best state according to the World Bank, the creation of village woodlots by the forest department has fared well, achieving 109 per cent of the target. But these are not self-help community woodlots. Landless families have been given small plots of government wastelands for tree planting. The Marxist lead United Front government has also ensured involvement of its party cadres in the programme, thus evoking a good grassroots response. Even then farm forestry in West Bengal has fared better, achieving 200 per cent of its target.

The Agriculture Ministry itself admits that the percentage of seedlings reaching farmers with landholdings of more than 2 hectares has been 61.5 per cent in Haryana and 57.6 per cent in Gujarat. Jammu and Kashmir and West Bengal have fared better: this percentage there is down to 35.3 per cent and 19.5 per cent respectively.

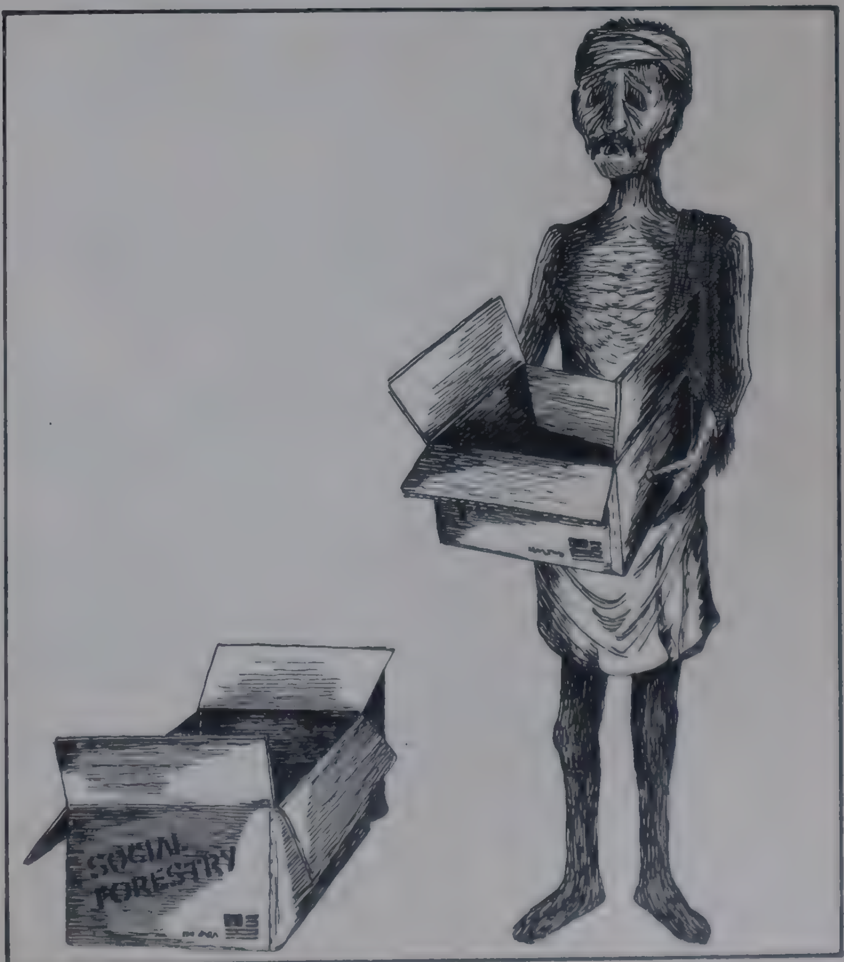
A significant result of the success of farm forestry—the "spontaneous response of small farmers or communities to the commercial incentive of rising prices (for wood) and the perception that farming fast-growing short rotation trees as a cash crop can be as profitable as farming some of the traditional cash crops", as a World Bank document puts it—is the conversion of large tracts of prime agricultural land to tree farming. In Uttar Pradesh, the average area to be planted annually under farm forestry was targeted at 2,800 hectares over a four-year period between 1979 and 1983, but over 98,000 hectares have actually been planted. Seedlings sold by the social forestry wing have been cornered by farmers owning over 4 hectares. In eastern Uttar Pradesh where landholdings are extremely fragmented, peasants extremely poor, and the energy crisis extremely acute, farm forestry has fared poorly. This is yet another indication that it benefits better-off farmers and does little to meet the energy needs of the poor.

The fact that seedlings are distributed free or are heavily subsidised essentially means that the programmes, started with the professed aim of meeting the dire fuel and fodder needs of the poor, are becoming a scheme of subsidies to support lucrative cash cropping by the rich. Additionally the fact that seedlings are often not available immediately after the rains means that small farmers with unirrigated lands cannot take as much advantage of subsidised seedlings as rich farmers with irrigated lands can. In many states, irrigated lands have come under tree farming and in at least one state there are now demands to ban tree farming on irrigated lands so as not to affect food production seriously.

### Farm forestry

A major reason for the distortions in social forestry programmes is the acute shortage of building poles in the urban market and of pulpwood, required by the rayon and paper industries. The active propagation of farm forestry by the government and the financial incentives it holds out has come as a windfall for the big farmer. Labour needs go down when farmers switch from short-term agriculture to long-term tree farming and they can even contemplate becoming absentee landlords. If they plant a tree like eucalyptus which is not palatable to animals, supervisory problems are also reduced.

However, for the landless in the village, this can be a real disaster. For instance, in Punjab, an influential farmer with over 100 hectares of land switched over from cotton to eucalyptus farming. The change in the type of biomass being produced created immediate energy problems for the farmer's labourers who earlier got cotton sticks regularly for fuel. Now they get nothing. After five to seven years, when the eucalyptus is harvested, they might get the lops and tops, as the trunk will go to the urban market and that only if the farmer is unable to sell the lops and tops of the tree. There is every reason to believe that with social forestry, India is getting into a new green revolution which will probably increase wood in the villages but will also make the poor even poorer in terms of energy.



A major reason why farm forestry has become such an overwhelmingly dominant component of social forestry is, what the World Bank calls, "project economic justification." Government strip plantations cost about Rs 4,200 per hectare and village woodlots Rs 3,000 per hectare and the internal rates of return for such plantations range from 12 per cent to 15 per cent. By contrast, the cost of farm forestry is about Rs 1,600 per hectare and the internal rates of return are of the order of 25 per cent to 30 per cent. Concludes a World Bank document: "This comparison clearly reinforces the conclusions now being drawn by the community forestry wings' project management that farm forestry is likely to be the least costly and economically the most effective approach to afforestation of the rural areas and that a major thrust of project development in the future should be in this direction."

One of the best indicators of the insensitivity of the World Bank to the needs of the poor is the fact that all its documents harp on the importance of fuelwood, almost without any mention of the fodder problem, while there is no reason to believe that the fodder crisis is any less severe than the fuel crisis, if not more. Even the weeds that take over degraded lands can provide some fuel but they provide no fodder. They spread only because they are not palatable to animals. The World Bank and foresters are happy to spread eucalyptus, a plant which specifically cannot provide fodder—a plant which socially speaking has all the characteristics of a weed—and yet make loud claims about the social relevance and success of social forestry.

The champions of "commercialised social forestry" assert that the gains of farm forestry far outweigh the losses. By increasing the wood available for urban and industrial purposes, pressure on natural forests will be reduced. Pro-eucalyptus economists argue that once wood supply overtakes industrial and urban demand, prices of wood will fall and farmers will diversify their plantations. But they do not answer why farmers will go on to produce wood for the poor who cannot pay.

That the commercial wood market is of key interest to the World Bank can be seen from the following paragraph

## Gujarat: Many Trees Little Firewood

Community forestry activities in Gujarat received a big boost with the five-year $67 million project, which began in 1980. Its targets were 37,000 hectares of strip plantations along the sides of roads, canal banks and railway lines, 68,440 hectares of village woodlots and the distribution of 150 million seedlings for farm forestry.

Farm forestry has been the most successful component of the programme, achieving 202 per cent of the targets between 1980 and 1983. By the third planting year, 95 million seedlings were being distributed and in 1984-85 the community forestry wing expects to distribute 250 million seedlings. The majority of farmers are opting for eucalyptus—80 per cent of the seedlings handed out are eucalyptus—and leucaena (subabul) as fast-growing cash crops.

A World Bank review notes that many farmers have converted irrigated land to farm forestry partly because of uncertain prices for some agricultural cash crops and partly because tree farming poses less labour and management problems. Now, increasingly, even smaller farmers have been encouraged by the profits of the larger farmers to plant the more commercial species of trees.

Of the 260,000 farmers who have received the seedlings, 87 per cent were small and marginal farmers, who also owned 72 per cent of the total land—about 72,000 hectares—under farm forestry. The forest department claims that only 5,000 hectares have been converted from foodgrains to tree farming. It is mainly land which was under cash crops such as cotton, or fallow land which has gone to tree farming.

There is no doubt that there is money in those trees. Kalidas Patel of Vatva in Ahmedabad district switched from hybrid cotton to eucalyptus in a big way by 1975 and now earns Rs 6,500 per hectare per year. He claims that eucalyptus farming has helped to raise the underground water table and reduce alkalinity. A farmer in Banaskantha recently sold 10,126 four-year-old eucalyptus trees for Rs 2.5 lakh to a merchant who passed them on for Rs 5.25 lakh. A Harijan farmer in Baroda district paid off a long-standing loan from the sales of 700 of the 1,200 eucalyptus trees he planted. A government survey reveals that 61 per cent of the farmers took to tree farming because they found it more profitable than agriculture.

But there is a cloud above these new plantations. Gujarat community forestry has not achieved much for rural community needs of fuel and fodder. The World Bank review itself states: "Notwithstanding the positive achievements to date . . . some areas remain a cause for concern, particularly whether small farmers will continue tree planting once obvious cash markets for poles and fuelwood have been supplied, the extent to which the project will benefit the landless, the weakness of forestry extension services and the possible overproduction of some forest products such as poles."

Fodder and fuel needs were intended to be met by the village woodlot component of the programme. A minimum of 4 hectares were to be set aside for fuelwood and fodder trees by village panchayats, and the profits shared by the panchayat and the government. Villagers could collect grass, fodder and fruit free. Between 1974-75—the scheme began well before the World Bank project—and 1981-82 the number of woodlots rose from 124 to 1,151 and the area planted from 906 hectares to 6,143 hectares, covered with acacia, subabul, tamarind, eucalyptus and bamboo, among other species.

With the community forestry project in 1980 the emphasis shifted to optimising the production of firewood and fodder. But how has this scheme benefited the villages? Nowhere has the produce gone to it. A study by a senior Gujarat forest official bluntly states that it has remained a government programme. The subsequent village self-help woodlot scheme, with greatly increased community responsibility for the plantations, has also not taken off.

Anxious to disprove the charge that only well-to-do farmers benefited from the subsidised tree farming bonanza, the forest department initiated in 1977 a scheme of raising teak and bamboo plantations on the land of Dangi tribals in the district of Dangs. The teak and bamboo crop is expected to yield better financial returns than the uneconomic agriculture they now practise on the hill slopes. To compensate the tribals for the loss of their livelihood, the forest department gives the Dangis a subsistence loan at the rate of Rs 250 per hectare per year. The total amount will be an interest-free loan when the tree crop is harvested at the end of 15 years. This scheme is now in its fifth year of operation.

Is Gujarat's booming social forestry programme really designed to reach the poorest and the needy? A voluntary agency working with poor villagers argues that the forest department's extension workers have yet to reach poor villages. Targets are met more easily by working in good areas with progressive farmers. Social forestry schemes do not include the cost of transporting plants to villages at a great distance from the nurseries. And finally the agency found a serious lack of information on how to undertake the poor person's social forestry on poor land, that is, how to make social forestry truly social.

The World Bank report itself has a telling conclusion: "A primary objective of the Gujarat Social Forestry Project is to ensure that all rural households (2.4 million in number) plus the from one of its own documents: "Marketing studies are seen as a critical issue in . . . social forestry projects being funded by the Bank in India. It is becoming increasingly obvious that the rising prices for poles and fuelwood have been one of the main factors in stimulating farmers' interest in tree planting. Early definition of the size and geographic location of such cash markets can influence the siting of tree nurseries and the design of appropriate extension programmes."

**Revealing survey**

A model study prepared for the World Bank by the International Institute for Environment and Development on the wood market in Gujarat claims that World Bank officials are worried that if existing cash markets were to be satisfied in the conceivably foreseeable future, this market saturation could have an adverse effect on farmer and community response to farm forestry. The study, therefore looks into the existing and potential market structure for future project planning. It concentrates entirely on the commercial wood demand: urban firewood demand, demand for construction poles, sawlogs, wood for pulp and paper, and other wood products like activated charcoal, catechu (a tanning extract) and 'katha' (a condiment used in the preparation of betel nut). But nowhere does the study talk about the non-commercial firewood demand of the poor, as if that was never an objective of the social forestry project in Gujarat.

The study, which is to be used by the World Bank as a model for planning social forestry programmes in other states, goes into great detail about how the commercial wood market can be expanded to continue to promote social forestry. The study concludes:

"*The existing markets for wood, particularly for construction poles, are probably much larger than had been originally anticipated in the Bank's mid-term Review Mission of November-December 1982.* This is primarily because of very large markets outside the state that fall within a reasonable economic zone of haulage, particularly in Maharashtra and Rajasthan.

"In addition, enterprising and innovative individuals are actively considering potential markets that could be tapped, should any surpluses become apparent. The demand for wood products in India is exceptionally high, and the lack of a sufficient raw material base has greatly hindered market development. *If the raw materials become available through social forestry activities, it can be expected that new forest product industries will develop, particularly pulp and paper, wood-based panels, and saw milling industries.*

"Because a relatively large amount of wood will become available over a short period of time, there is some concern that *the current marketing structure may fail to protect vulnerable smaller farmers with little experience.* A promising sign is that wood grower's cooperatives have been formed in a few areas (emphasis in original)."

The study also talks of various new opportunities being discussed in Gujarat to expand the commercial wood market. For instance, it reports that there has been some discussion among farmers, particularly in Bhavnagar district, on establishing small-scale village mechanical pulping devices that would be capable of handling eucalyptus. They have also been discussing with the state Agro-Industry

**Progress in farm forestry in Gujarat (by end 1982-83)**

**BENEFICIARY FARMERS**

| Category | Number | Area planted (hectare) |
|---|---|---|
| Total | 150,000 | 31,496 |
| Large (> 4ha) | 30% | 36% |
| Small (2-4ha) | 55% | 46% |
| Marginal (< 2ha) | 15% | 18% |

**PATTERNS OF TREE PLANTING**

| | Proportion of farmers |
|---|---|
| Block planting on farmers' fields | 55% |
| On farm boundaries | 40% |
| Along irrigated channels | 5% |

**LANDS USED FOR TREE FARMS**

| | Proportion of Farmers |
|---|---|
| Fallow land | 27% |
| Land earlier under cash crops | 37% |
| Land earlier under food crops | 27% |
| Land earlier under mixed crops | 9% |

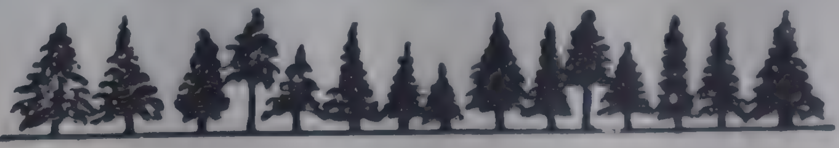
Source: Gujarat forest department.

8 million landless in the rural areas (about 1.3 million families) have ready access to fuelwood and fodder for domestic consumption . . . .and thereby reduce the amount of time women and children have to spend daily in collecting fuelwood. Also to encourage the diversion of animal dung from burning to use as an organic manure. No systematic analysis of these questions has yet been carried out in Gujarat . . ."

**Progress in government sponsored afforestation**

| | 1980-81 | 1981-82 | 1982-83 | 1983-84 (up to Feb) |
|---|---|---|---|---|
| Seedlings planted under afforestation programme (crore) | 84.67 | 131.88 | 207.85 | 229.08 |
| Seedlings distributed to public under farm forestry (crore) | — | 44.10 | 89.70 | 113.76 |
| Area planted under social forestry (lakh ha) | 1.53 | 2.54 | 3.75 | 4.07 |

Source: Annual Report 1983-84, Department of Agriculture and Cooperation, Ministry of Agriculture, New Delhi.



Board and the Gujarat Energy Development Authority the idea of wood-based electricity generating power stations whose power would be purchased by the state and fed into the central grid. Jyoti Ltd has been working on such a dendrothermal power plant. This company has also designed a wood gasifier-powered irrigation pump, which will extend the wood market further. The economics of the Jyoti system appears to be quite favourable, depending on the availability of wood. Units of varying sizes are expected to be put on the market in the near future. Another company has approached the forest department for establishing a hardboard plant in Bhavnagar area. Good quality eucalyptus timber could also be used by the shipbuilding industry along the coast. Essentially this adds up to a wood production, marketing and development scheme.

**Foreign aid assisted social forestry projects in India**

| State | Total Cost (million) | Estimated Foreign Assistance (million) | Period | Donor Agency | Area to be planted (ha) |
|---|---|---|---|---|---|
| Uttar Pradesh | $ 40 | $ 23 | 1979-84 | World Bank | 52,680 |
| Gujarat | $ 67 | $ 37 | 1980-85 | World Bank | 1,05,440 |
| Tamil Nadu | $ 47 | $ 33 | 1981-86 | SIDA | — |
| Madhya Pradesh | $ 40 | $ 25 | 1981-86 | USAID | 1,00,000 |
| West Bengal | $ 34 | $ 29 | 1981-87 | World Bank | 93,000 |
| Maharashtra | $ 56 | $ 30 | 1982-87 | USAID | — |
| Jammu and Kashmir | $ 28 | $ 13 | 1982-87 | World Bank | 44,000 |
| Haryana | $ 33 | $ 20 | 1982-87 | World Bank | 67,000 |
| Karnataka | Rs 552 | $ 27 | 1983-88 | World Bank/ODA | 1,49,000 |
| Andhra Pradesh | Rs 400 | $ 44 | 1983-88 | CIDA | 1,38,000 |
| Orissa | $ 23 | $ 18 | 1983-88 | SIDA | 57,000 |
| Kerala | Under consideration | — | — | World Bank | — |
| Bihar | Under consideration | — | — | SIDA | — |

Note: SIDA: Swedish International Development Authority; USAID: United States Agency for International Development; ODA: Overseas Development Administration (UK); CIDA: Canadian International Development Agency.

Social forestry has largely met urban needs. Casuarina poles grown on private farms being trucked to Madras. (Gerry Foley/Earthscan)

### Admission of failure

Access to fodder, fuelwood and building wood essentially means access to land and social forestry projects, if they are really to serve the neediest, must be directed to landless, small and marginal farmer households. The World Bank admits in its latest global review of World Bank-financed forestry activity that it has failed in this respect: "Ensuring adequate supplies of fuelwood, building poles and fodder for the landless, who in some developing countries number more than 25 per cent of the population, is probably the most difficult forest policy issue that most developing country governments face. Various approaches have been tried, such as government-sponsored establishment of roadside plantations or woodlots with preference in allocation of employment and output to landless families ... The problem of creating viable employment for the landless is an issue which can only be resolved by general economic growth, by movement of people out of the rural areas into industrial employment, b resolution of inequities in land distribution, by growth of the service sector, by development of markets for processed primary products and by other development-oriented interventions. Forestry's role in this area will remain marginal .... A second constraint is that of how to provide effective incentives to persuade small farmers to take up tree planting in situations where the main purpose of such tree planting is to create a supply of wood for domestic consumption ...."

The landless, in fact, are distrustful of social forestry programmes. The World Bank itself lists a number of reasons why response to community forestry efforts has been poor: heterogeneous village communities, mistrust of the system for ensuring equitable distribution of the produce from community woodlots, disputes amongst farmers concerning availability of the village common land for the establishment of village woodlots, and shortage of panchayat funds for payment of labour and protection of plantations. "The 'commons' problems is a particularly difficult issue as it affects the willingness of rural communities to cooperate in the establishment of village woodlots, and to protect them from grazing animals," admits the World Bank.

Surveys in Tamil Nadu show that the cattle-owning landless households are against woodlots on village commons because they are afraid this will further reduce the availability of grazing lands, block the ancient right of passage for carts, and reduce the supply of brushwood (the poor person's fuel). Also experience has shown the poor

### Tamil Nadu: The Credibility Gap

At Acharapakkam in Chengalpattu district of Tamil Nadu a eucalyptus hybrid plantation was begun in 1980. However, immediately after planting, 5,000 saplings were uprooted by villagers. This episode exemplifies the social forestry drive in Tamil Nadu, a drive which appears to have gone seriously astray. An evaluation of 20 years of farm forestry in Chengalpattu district (1960-1980) uncovered the disturbing fact that although 69 species were listed for planting, only two, babul and eucalyptus hybrid, dominate and the forest department persisted with eucalyptus even when the villagers demanded casuarina, because it was more suitable for fuel.

What is more, wood has been sold to paper mills at loss-making rates of Rs 80 a tonne, compared to Rs 275 a tonne in Kerala and Rs 205 a tonne in Karnataka. The cost of one social forestry plantation in 1981-82 was Rs 1,946, eight times the price fetched by the wood: Rs 244.

What was the reaction to social forestry in the state, especially in the years before the 10-year project of the Swedish International Development Authority (SIDA) began in 1981? A survey of 28 villages in Chengalpattu district found that 61 per cent of the villagers had no land to offer, another 24 per cent had land but were reluctant to make a long-term investment with delayed returns, while only 15 per cent were willing to give their land. As many as 97 per cent said they had not even been approached by the forest department.

A baseline survey conducted before launching the SIDA-aided project in Tiruchirapalli, Pudukottai and Thanjavur districts found that while the panchayats were in favour of the scheme because they thought it would bring them added revenue, the villagers themselves feared that if the forest department gave seedlings they would lay claim to the land. In fact, only three out of 90 respondents were willing to offer their surplus and wasteland to the forest department and these three were fairly well educated. Most villagers wanted eucalyptus and casuarina in these three districts, while in Salem the choice was tamarind and neem.

People's participation is crucial for any social forestry project but in Tamil Nadu one aspect of the planting has created serious problems. The state has 31,000 small tanks which irrigate less than 100 acres each and about 7,400 large ones which are maintained by the state public works department. Over three-fourths of public plantations are envisaged for the foreshore areas of these tanks, common lands called 'poramboke' lands, which belong to the government. But poorer villagers oppose this: they use the lands for grazing and a large part of the poramboke lands have also been encroached upon for cultivation.

The Tamil Nadu government, sensing major opposition, instructed the forest department to look to the encroachers' interests wherever the poramboke lands had been used for cultivation for a long time. The report of the Social Forestry Monitoring Board in 1982 clearly stated that "there is no clear social justification for withdrawing land from the poor in order to be able to provide them with fuel at a later date". The report also cautioned against "any reduction to public grazing facilities" because this particularly affected the poor.

The protection of plantations has become a major problem. Cattle damage them, illegal felling, both organised and unorganised, takes place, scarcity conditions force villagers to fell trees prematurely. All this happens because the people are not adequately involved in the process. As the monitoring board report says bluntly: "There is generally no evidence that the village community was consulted in any systematic fashion in choice of lands for plantation or in the choice of species, or that their cooperation was sought in maintenance and protection."

The auctioning of forests to contractors also provokes resentment. They often bring in outside labour and, frequently, even the brushwood and loppings, which the villagers are supposed to get at concessional prices, are sold in the market. Most of the wood in some villages went to a pulp mill. The report on social forestry in Tiruchirapalli, Pudukottai and Thanjavur (west) districts says that in almost all cases, the contractors cut and removed the entire biomass without leaving a single twig on the site. As the report concludes on a note of sadness: "There is every reason for the local villagers to get disillusioned with the whole concept of 'forestry for the local community'."

that the produce from such community efforts seldom reach them. Both Madhya Pradesh and Uttar Pradesh have tried to ensure equitable distribution of the usufruct by drawing up elaborate contracts between the panchayats and the social forestry directorate. But as experience in a village in Sultanpur district shows, despite a list of the "poorest of the poor" being made by the village pradhan, the actual distribution of firewood was in favour of the landed; the landless got nothing. Uttar Pradesh and its donor World Bank, are not even pursuing such contracts in other villages because they consider it a futile exercise.

The World Bank's reaction to this failure exemplifies its limited commitment to get social forestry programmes serving community needs. The Gujarat social forestry appraisal report describes how project staff are resorting to management decisions to "increase the size of the farm forestry programme, to reduce expectations under the village self-help component and to increase the forest department supervised village woodlot component". In other words, if self-help woodlots have not met with success, forget the poor and switch to farm forestry. J. Bandyopadhyay, one of the authors of the Kolar study, strongly questions the propriety of international borrowing for financing social forestry programmes mainly executed by rich farmers, and whose benefits do not reach the poor. If social forestry is so profitable why should there be any subsidies, especially those which make the country indebted to foreign bodies, he asks.

In many states additional resources for social forestry have been mobilised by linking it to the National Rural Employment Programme (NREP) and the Integrated Rural Development Programme (IRDP). In Delhi, Madhya Pradesh, Uttar Pradesh and Gujarat, trees are being planted on public lands with seedling provided by the forest department and the wage component funded under NREP. In Gujarat the self-help component of the community woodlots scheme picked up momentum after the forest department decided that the poor and the landless should not be expected to volunteer their labour but should be paid out of NREP funds. However, this has only led to some token social forestry with an eye to obtaining more funds. In Pudukottai District of Tamil Nadu, for instance, it was found that because of the stipulation for receiving grants under IRDP or NREP, most of the panchayat unions had reluctantly raised plantations, but these were neglected.

The World Bank and the forest departments do not admit that tree farming is eroding rural employment but they do not produce any hard data or studies either to prove otherwise. Figures produced show that social forestry is creating employment but no comparative studies have been published to show whether this employment is less or more than cultivation would generate in irrigated and non-irrigated conditions. The Kolar study estimates that for each hectare of land shifted from food crops to eucalyptus, there is a loss of about 250 person days of employment per year. Other experts, however, argue that forest plantations can increase employment for the rural landless when compared to food crops.

A major failing of the social forestry projects is the lack of involvement of poor women who ought to be the main beneficiaries. It is women who collect fuel and fodder every day for the family and the male orientation of the projects has, not surprisingly, turned them into cash-generating rather than basic needs generating exercises (see People chapter).

### Social Forestry: Madhya Pradesh

Madhya Pradesh has the largest per capita availability of forests in India, yet 26 of its 45 districts suffer firewood and fodder shortages. The state needs 10 million cubic metres (mcum) of firewood, but only 4 mcum is available. It requires 58 million tonnes of green fodder, as against a supply of 32 million tonnes. Grazing is a major problem and there is virtually no stall feeding.

Long before the Rs 50 crore USAID–supported social forestry project, the forest department began afforesting part of the 6 million hectares of wastelands in the state through panchvans, plantations of around 35 hectares each located near a cluster of four or five villages to whom they would be handed over after five years. Using hardy species such as amla, the panchvans grew well, reclaiming degraded and laterite lands and pushing back the ravines. However, after the five-year deadline, the forest department is extremely reluctant to hand them over to the villages: their argument is that they are not sure that the produce from the panchvans will be distributed fairly.

As with the panchvans, so with the community plantations of 50 hectares to 70 hectares each. Work began in 1983 and by end-1983 176 plantations had been established and the survival rate was good. However, the authorities found that it was easier to plant trees than to persuade the villagers to take care of them and properly distribute the benefits—the social forestry directorate has had to go to the extent of signing 10-year management and distribution contracts with the panchayats.

The mid-term review of the plantation scheme expressed doubts if the community elite would allow the poor an equitable slice of the cake. And the poorer villagers endorsed this verdict: they were uniformly pessimistic about getting their share of fodder and firewood. In one village only 30 families had been allowed to cut grass, the landless were not even told of the grass availability, and few were shooed away when they turned up with their sickles. The poor favoured a system whereby each family was allotted designated trees.

The review mission also strongly suggested that farm forestry be made a major component of the forestry drive. Roadside plantations had too high a mortality rate. The reason given is that farm forestry is the quickest way to reach a large number of farmers and produce a large volume of wood at low cost, as it supplements the community plantation effort.

The Madhya Pradesh social forestry effort is the only one in the country to recruit women, 'van sevikas' trained at the social forestry training school at Shivpuri. There have been problems—more urban women than rural are attracted because of the high qualifications required and these then scramble for urban postings. Also men foresters in some areas have not accepted women. But the presence of women does seem to draw more local women into the forestry effort.

Although the districts with good forest cover have not been included in the social forestry project, here too schemes are on to augment fuel and fodder supply to villages. In Bastar as in certain other districts, degraded forest land is now being reclaimed under the 'hitgrahi' scheme which gives the poorest tribals in the covered villages usufructuary use of trees they plant on forest land with the forest department's aid. Every year tribal beneficiaries get an additional 10 hectares to manage until they have trees covering 60 hectares. The saplings are of fruit, small timber and bamboo. The scheme needs to be restructured to cover more people with smaller acreage.

Smitu Kothari

### Shifting priorities

Whatever propaganda the World Bank officials may continue to use for their ignorant admirers in Washington, in India they have kept a low profile. In private, World Bank officials admit that, having learnt their lesson, they are now stressing afforestation of degraded forest lands as an important component in social forestry programmes to meet primarily the fuel needs of the poor. They insist that the World Bank is now increasingly emphasising individualisation or privatisation of trees grown on degraded forest lands. Right to the usufruct of the planted trees will be given to poor households living near such lands.

In West Bengal, for instance, small plots of government-owned wastelands are being allocated to landless families for tree planting. The landless do not get the title to the land, but they are given full right to the usufruct of the trees they plant. Both wages and seedlings are given at the planting stage. States like Gujarat and Maharashtra have also developed schemes to involve the landless in tree planting but it is too early to evaluate these schemes. Certain reports indicate that the forest departments show little interest in these schemes and tribal families are reluctant to take advantage of them for fear of getting involved in something that may only harm them in the long run. Voluntary agencies may have to play an important role in organising the poor to take full advantage of these schemes.

In any case only those landless families can be involved in these schemes which live close to degraded forest lands. Moreover, any major move to settle the landless on degraded forest land will face strong opposition from wood-based industries which are pushing for allotment of such lands to them, to meet their own wood requirements.

### Uttar Pradesh: Big Farmers Forestry

The World Bank aided social forestry project begun in 1979-80 has given a significant boost to forestry in Uttar Pradesh. At the outset, the state forestry development budget (both industrial and social forestry) accounted for 1.25 per cent of the total state development budget. By November 1982, it had risen to 2.25 per cent. At the end of the projects first four years, the pace of social forestry planting had increased 20-fold, from 500 hectares a year to 12,000 hectares.

Farm forestry has exceeded all expectations. The number of seedlings distributed by the end of 1982-83—156 millions—was 30 times the target. Of these 156 million seedlings, the cost of 51 million was borne by the World Bank aided project and the rest by the National Rural Employment Programme. The chief reason for the boom is the rising prices of commercial fuelwood, building poles and fodder,which has encouraged farmers to take up tree planting as a cash crop. The larger farm sizes in western Uttar Pradesh have favoured farm forestry and the response to it has been most positive in this area. There has been a rapid increase in the number of nurseries. In rural areas, the number of nurseries increased from 148 at the programme's inception to 645 by the end of 1982-83 planting season. However, these nurseries were all owned and operated by the Uttar Pradesh social forestry directorate. Nurseries owned by schools numbered only 23.

In the Bareilly region, for example, out of 96 farmers who planted seedlings during the 1982-83 season, 65 per cent planted more than 1,000 seedlings. The World Bank review mission admitted: "Few small farmers planting fuelwood, fruit and fodder trees for domestic consumption have so far participated in the project."

In eastern Uttar Pradesh, with much smaller farm sizes, poor quality soil and low per capita incomes of farmers the response has been minimal. The energy crisis is also more acute in this region.

The state government has insisted on recovering the cost of the seedlings from the farmers, seeing that the richer and larger farmers of western Uttar Pradesh are benefiting from the programme. The forest department was charging 10 paise per seedling in 1982 and the government wanted this increased to 30 paise per seedling. The World Bank and the state's foresters argued that this would harm the interests of small farmers, even though the project had largely failed to reach small farmers. They then suggested that 200 tree seedlings could be distributed to a farmer after which a nominal price could be charged. The World Bank cited the case of Gujarat where any farmer, large or small, can take as much as 10,000 seedlings.

Progress in village woodlots has been patchy. Some 5,083 hectares of government-planted village woodlots had been set up by 1982 as against a target of 3,540 hectares. But the self-help village woodlots scheme achieved only 8 per cent of the target. It was expected that the village woodlots would be taken up by the panchayats for management and future protection. But no panchayat leader was prepared to protect anything from fellow-villagers. The forest department was not very pleased to be saddled with their protection, especially when the panchayats were not prepared to help. There were also problems with distributing their benefits: an average woodlot of 3 hectares could benefit at most 20 per cent of the population. The only thing that could be said in favour of them was that they employed a few landless persons.

A fundamental reason for the failure of the social forestry programme to help the most needy is that it expects an unrealistic degree of collaboration between the villagers who use the forests and the forest department personnel who police them. Many villagers in Gujarat, Madhya Pradesh, Uttar Pradesh and elsewhere are reluctant to let the forest department afforest their common lands for fear that they may claim the afforested areas as theirs. Poor rural families have even been reluctant to accept saplings distributed free for homestead plantations through social forestry projects for fear that planting them will somehow give the forest department a claim to the land.

Foresters too, do not relish the new role thrust upon them of wooing the rural public as partners in afforestation. A young divisional forest officer in Madhya Pradesh sums up: "We used to be kings (of the forests), now we have to go as beggars (to persuade people to plant trees)." It is clear that there has to be a fundamental change in objectives and attitudes if the social forestry programme is to make a lasting impact in areas where such an impact is of prime importance.

## Growing Up

The Mahatma Gandhi Vidyalaya is a secondary school in Urali Kanchan. Eighty per cent of its 3,000-odd students are from farmer families. This in itself is nothing extraordinary, but what sets the school apart is that its students have carried out a phenomenally successful subabul plantation programme which should see more than 3 lakh trees flourishing, tended lovingly by children.

The programme is the brainchild of the Ramon Magsaysay Award-winner Manibhai Desai who started the school in 1950 and the nearby Bharatiya Agro-Industries Foundation (BAIF) in 1967. BAIF has done pioneering work in the last 10 years on the fast growing fuel and fodder tree subabul and in 1980, Desai distributed 5,000 saplings of the tree to children on Van Mahotsav Day. The first year, only 40 per cent survived, mainly because of a drought. The next year a more ambitious plan involving 100,000 saplings from BAIF was worked out and since then the scheme has never looked back.

Costs work out to 40 paise per tree, including the cost of each sapling at 20 paise and rewards to students for outstanding performance. As against this, progressive farmers in Gujarat have calculated that they need an investment of about 80 paise per tree. Forest department costs are likely to be even higher as they do not have the advantage of community participation.

Not surprisingly, other schools have also become interested in the scheme. Desai is planning to extend the afforestation programme to 100 schools in the region in the next few years. The logistics are enticing. It is estimated that 100 schools can raise 5 crore trees in three years. A rough estimate of the number of schools within the ambit of the BAIF infrastructure is 5,000 and afforestation through this system could mean 150 crores of subabul in three years. Such a programme could radically change the fuel and fodder picture not only in these areas but all across India.

The enthusiasm of the children for the scheme has to be seen to be believed. In Urali Kanchan, Kanchanlal first planted 200 saplings on his family farm; all survived and he asked for 3,000 more. Another child lives in a joint family which owns 20 cows and 12 bulls; they are delighted with the green fodder from the 900 subabuls which the child brought home. A landless boy, whose mother runs a tea shop on the highway, planted 80 saplings and all survived. The tea shop is located on land which belongs to a farmer and the mother says that the trees give fodder for his cows which earns her his goodwill.

In Gujarat, the forest department has been encouraging school nurseries to meet the seedling demand for the state-wide afforestation programme. The number of school nurseries increased from four to 677 between 1979-80 and 1982. The principal reason for the rapid increase was the fact that the schools were encouraged to grow trees under a contract which guaranteed them a price of 15 paise per seedling.

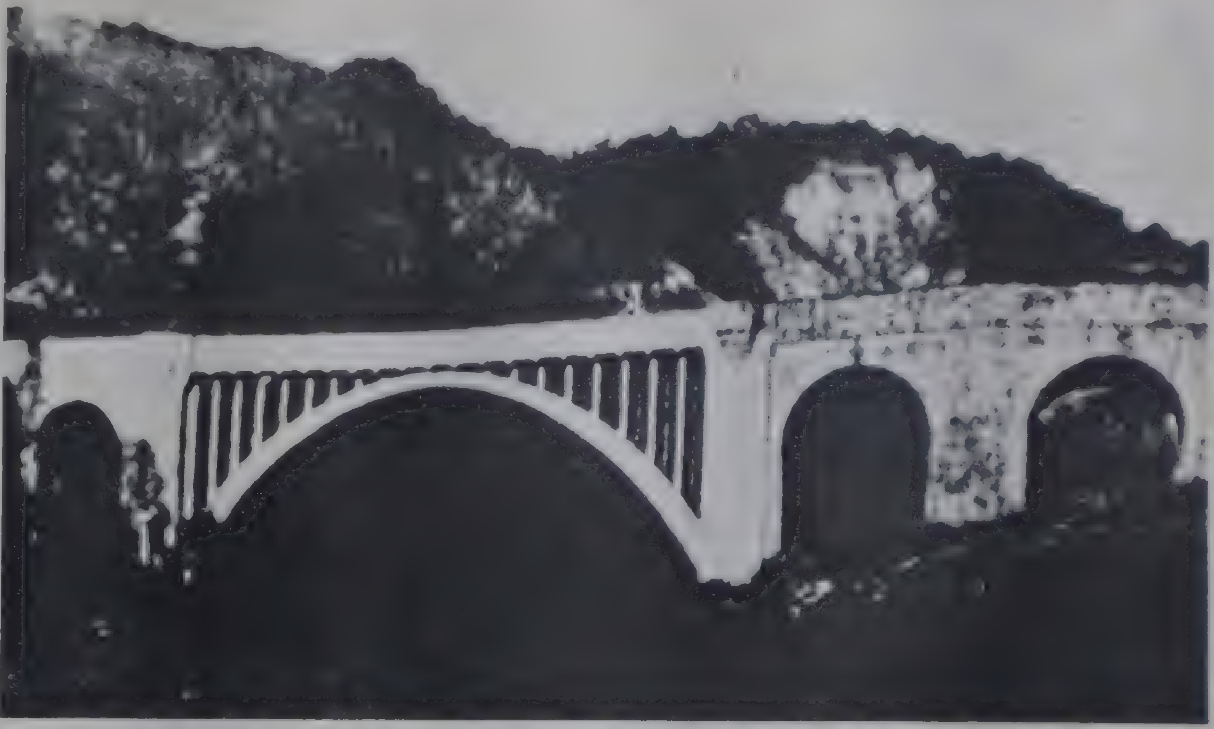
Unfortunately, the central government's efforts to tap this enormous reservoir have been lackadasical. Some time ago, a meeting was called by the Union agriculture secretary to discuss the role of schools in afforestation, attended by 15 people representing almost all relevant ministries and departments. Those present pointed to the example of the Mahatma Gandhi Vidyalaya and resolved to take the necessary steps to involve the 640,000 primary and secondary schools in the country in afforestation. All India Radio even volunteered to broadcast in various languages how-to-do-it information about tree planting and raising.

But months later, it was obvious that all this talk was just so much hot air. In Rajasthan, for instance, the education department's request for seeds and saplings, made to the forest department, evoked no response. In Punjab, the head of a large educational institution was told by a senior forester that the department had no seedlings to spare for children. It is clear that it will be a long time before the Urali Kanchan success or even that of the officially sponsored efforts in Gujarat is repeated on a large scale by other schools in India.

**Children tending seedlings — Gujarat has nearly 700 school-run nurseries. (A.S. Kochar/WHO)**

## Bridge Over Rubbled Waters

Linking Dehra Dun and Mussoorie, in the hills, is a road, which has to cross many small rivers. Nearly 70 years ago, a bridge was built over the Kaulagarh Nullah, near Rajpur. At the time when it was built, the bridge cleared the bed of the nullah, then a narrow rock channel, by 20 metres.



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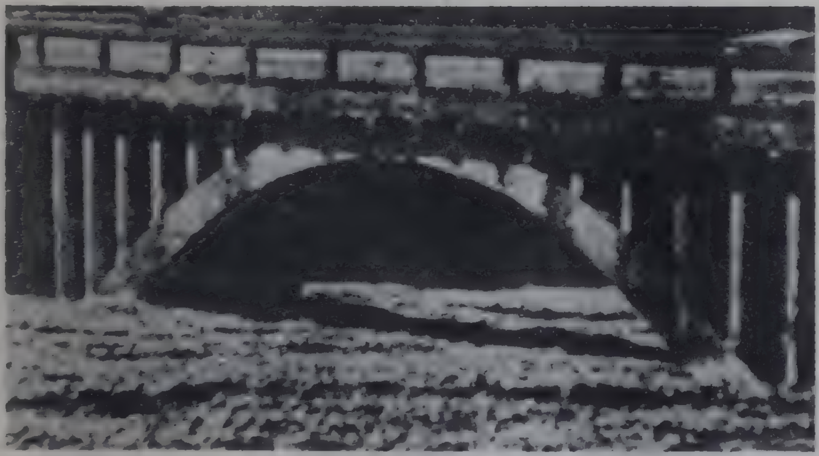
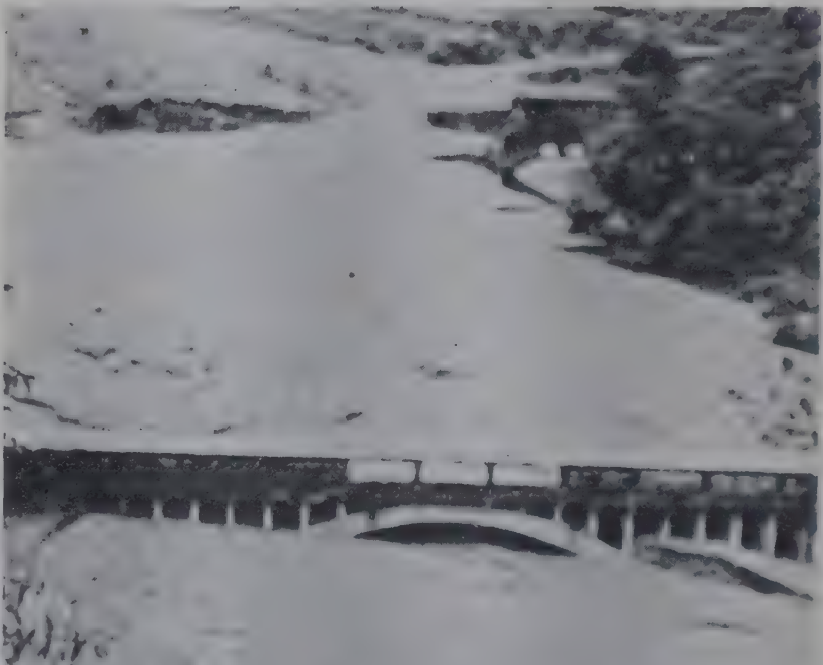
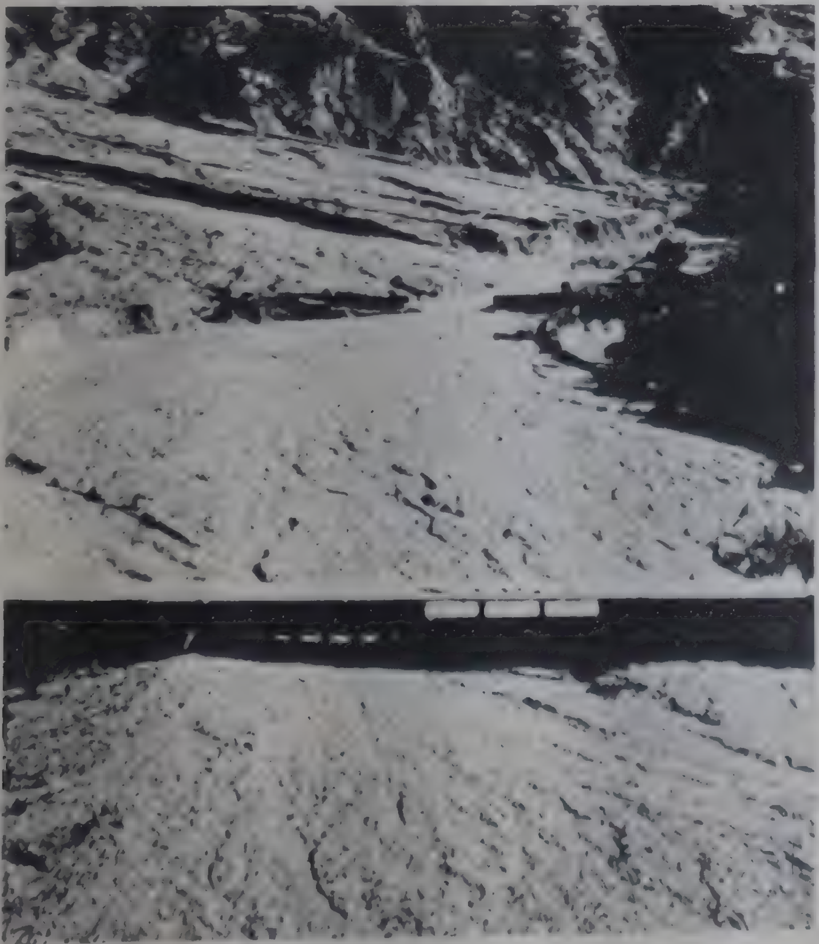






Martin Haigh

The small catchment of the stream in the Himalayan foothills has since suffered deforestation on a large scale, as well as quarrying. Landslides have been occurring with disturbing regularity and soil erosion is increasing too.

As a result, the channel has become full of boulders and silt. By 1942, the level of the nullah had risen, as is evident from the second picture. In 1980, when the last two pictures were taken, the arch of the bridge barely cleared the dry nullah bed by a metre. The ground has literally been rising at the frightening rate of one foot every year. As the long shot of the bridge shows, the surrounding hills have been heavily deforested and are fast becoming devoid of almost any vegetation whatsoever. At this rate, it won't be long before the bridge becomes totally covered with silt.

## With a Little Help from Friends

If the participation of common folk is conspicuous by its absence in the huge, multi-crore social forestry projects in several states, it is the most noticeable element in many voluntary efforts at afforestation. Though individually small in outlay and scope, they are today the most heartening forerunners of the green revolution that this country so urgently needs. The movements draw their momentum from the enthusiasm of schoolchildren, hard-working hill women and impoverished tribal farmers. And because they have grown out of felt needs, they promise to endure.

In south Gujarat, where there is oppressive poverty, trees are being planted by the crores in the tribal taluks of Vyara and Dharmpura. Under the urging of local social worker and politician Jinabhai Darji, tribal children in ashram schools, marginal farmers and panchayat leaders have raised lakhs of saplings in nurseries, and planted private lands, school grounds and wastelands in these two taluks. The survival rate is a very healthy 90 per cent. The forest department has helped, and the collector's office has added its mite by preparing maps, identifying wastelands and water resources.

Elsewhere in south Gujarat, Harivallabh Parikh's ashram in Rangpura is using the famous lok adalats (open courts) to spread the same message. The tribals who come to the court sessions are told of the importance of social and farm forestry and cited examples of tribal villages that have already accomplished impressive afforestation. As a result, two tree growers' cooperatives have evoked a good response: one has members from eight villages with 1.8 lakh trees, the other, members from two villages with 91,000 trees. Contractors have already offered the tribals a reservation fee of Rs 20 per tree. The Rangpura ashram raises and distributes lakhs of saplings. It has settled landless families on wastelands, and is planning to lease the denuded hills behind the ashram from the government for afforestation. The ashram spent Rs 50,000 in one year on diesel alone in transporting saplings to various villages.

Mahiti is another voluntary group based in Gujarat that seeks to awaken the poor in tribal villages. A report by them describes the problem it faced when it was told by the forest departments that it would have to transport the saplings to the more remote villages since the department did not have the funds to do farflung extension work.

### Laudable labour

Khirakot is a village in Almora district where villagers, especially women, won a battle against a soapstone quarrying company which was ruining the environment. Considerable deforestation had occurred because of the quarrying, and fields were being covered by rubble. In March 1982 the villagers won a legal victory that prevented any further extension of the lease held by the mining company. Plantation camps have been subsequently organised in 1983 and with assistance from a donor agency, afforestation of the quarried hillside has taken place. But the heavy burden of both domestic and agricultural work has prevented women from continued active involvement.

Many other voluntary groups involved in afforestation are based in the Himalayan foothills, most of them in the Uttarakhand region of Uttar Pradesh. A Chamoli-based group, the Tungsa Gram Seva Sansthan, has developed a network of nurseries in villages for horticulture, fuel and fodder species. A team of young people trained in afforestation techniques helps other local organisations engaged in social forestry activities by giving them saplings and technical advice.

The Parvatiya Yuva Morcha in Almora district organises foot marches in the district to spread forest consciousness. It has also started organising plantation camps in adjoining districts. Another Ranikhet-based voluntary effort is that of the Lok Chetna Manch which undertakes foot marches, organises plantation camps and is setting up its own nursery in Ranikhet town.

The Doodhatoli Parikshetra Vikas Samiti in Pauri Garhwal district has covered 15 villages in an afforestation drive. It has introduced environmental education to local colleges has developed a small nursery and collects the seeds of local species. The Doonghati Shikshan Sansthan in Dehra Dun district is raising plantations of fuel and fodder trees in the Himalayan foothills with the help of a women's group.

A leading voluntary organisation in Andhra Pradesh is the Bhagavatula Charitable Trust (BCT) in Visakhapatnam district. The trust acquired 20 hectares on the slopes of the Dharapalem hills on a 20-year lease from the government and galvanised the local people to cover the land with trees to fulfil local needs: bamboo, eucalyptus, cashew, coconut, subabul and various fodder grasses. Fruit, flower and vegetable farming have also been introduced. About 125 marginal and small farmers have offered part of their land to BCT.

### Striking success

Voluntary efforts tend to be related to the actual needs of rural populations in terms of species. The more striking experiments in recent years have been those of the Dasholi Gram Swarajya Mandal in Chamoli, the Bhagavatula Charitable Trust in Yellamanchilli, the Bharatiya Agro-Industries Foundation in Pune, and the Ranchi Consortium for Community Forestry in Bihar.

But a number of other groups are also venturing into this field; such as ASTRA (Centre for Application of Science and Technology to Rural Areas), a group of scientists and engineers based at the Indian Institute of Science in Bangalore. They persuaded the villagers to raise an energy forest on 3 hectares of fallow land around Pura. A 2 hectare plantation of quick-growing species such as casuarina and subabul, after a gestation period of three to five years could provide enough firewood to meet the annual requirement of a village of 50 to 60 households.

The Banwasi Seva Ashram at Govindpur in eastern Uttar Pradesh is undertaking social forestry programmes on private and community lands and lands under bunds and ridges. Nearly a thousand farmers have donated part of their land and space along their bunds for this purpose. In 1982, 50,000 saplings of subabul, jackfruit, acacia and casuarina were planted. To raise one lakh saplings for the plantation programme of 1983, 10 villagers established nurseries on their lands.

Action for Food Production, a non-profit organisation which assists village-level efforts at enhancing food production has made afforestation an integral part of its land and water development project in Jalna district in Maharashtra. Since 1981 about 700,000 subabul and 10,000 trees of neem, tamarind, bamboo, sissoo, and albizia have been planted on bare and rocky land.

The Kasturba Gandhi National Trust at Indore has adopted five villages in the vicinity of Kasturba Gram. The villages were persuaded to spare several one-hectare plots for planting trees and grass. In 42 villages in Indore and Mhow tehsils, villagers are provided with a family package of seedlings for homestead plantation. The species included are jamun, guava, drumstick, neem, subabul and bamboo. The first year seedlings were provided free of cost, in subsequent years a nominal charge of 20 paise per plant was levied. The trust says the response from the villagers continued to be overwhelming and the survival percentage improved to 90 per cent.

### Experimental models

The Ranchi Consortium for Community Forestry which was formed in July 1979 has to date initiated plantations of more than 3 lakh mixed species in 250 hectares spread over 39 villages. The consortium has experimented with four models of community forestry. One envisages plantation on community lands with seedlings provided by them, planting operations carried out by the villagers, and protective fencing provided by the forest department. In the second model plantation is done on private lands with work done by the owner and seedlings provided by the consortium and the forest department. In the third model the consortium provides villagers with financial assistance for their own social forestry. The fourth type is on private lands with the forest department carrying out all the operations.

The consortium has also initiated two social welfare programmes in the villages surrounding their initial project area, 35 km southwest of Ranchi. Every child in the village is given a sapling to plant at home and look after. At the end of a given period the child adjudged the best caretaker is given an award. The project is handled by a "gram didi" who is a matriculate and comes from a tribal family.

The consortium has also supplied about 50 primary and middle schools with fruit trees to raise orchards; one period of about an hour's duration is allocated in these schools for training in gardening and forestry. The produce is distributed free to the children, and surplus fruit is sold and the returns used to help the poorer children.

**Simple techniques**

The Youth Hostels Association of India (YHAI) which has clubs called Millions of Trees in various parts of the country, has developed simple, cheap techniques for young people, including "primitive" techniques such as "dibbling" of seeds—making holes in the ground with a pointed stick and dropping seeds in them. YHAI believes that only cheap, primitive techniques can bring about a true tree revolution. School children attending work camps in the west coast, north of Mangalore have dibbled thousands of seeds of palmyra, giving a new lease of life to a species that was slowly dying out because villagers steadily cut it down to make roofs. The YHAI is also keen to set up a chain of "people's nurseries" owned by marginal farmers who have less than one hectare of land. "It is our dream that a day will soon arrive when, in almost every 16 km in rural India, there will be one such 'people's nursery'," says Ben Soans, secretary of the south India branch of the YHAI.

Other experiments with community forestry, however, have only reinforced the finding that it is very difficult to involve the very poor. CROSS, an Andhra Pradesh based voluntary organisation, set apart 40 hectares because the soil was mostly alkaline and saline. It attempted to grow prosopis, fodder species, eucalyptus and subabul. The survival rate was around 3 per cent. CROSS analysed the situation and put down the failure to problems of stray cattle, general drought conditions prevailing in the area, and the attitude of the village people. They felt that farmers were unwilling to raise trees with long gestation periods, the poor beneficiaries needed to work as wage labour and could not spare time to look after these trees, also, lack of an assured market for produce was a disincentive.

For future forestry programmes CROSS has decided not to use any land that can possibly be used for cultivating food crops. They have also decided to consult women about this activity since fuelwood is more their felt need than that of men, and to use their religious association with trees as a motivating factor.

**Easing tensions**

Work being done by several other voluntary organisations is aimed less at planting trees and more at easing the tension that envelops the lives of forest people. The People's Institute for Participatory Action Research (PIPAR) has had to organise the tribals in Dhenkanal district in Orissa against woodcutters. Every day 40 to 50 armed outsiders, mainly from the borders of Cuttack and Dhenkanal districts come on bullock carts to the tribal villages situated in the dense Kapilash forest and brazenly and illegally cut wood in broad daylight. The woodcutters are supported by saw mill owners and timber merchants. Once they leave, the tribals have to face the wrath of the forest officials.

Finally, in August 1982, with the help of PIPAR, the tribals got organised and began to warn the woodcutters against further intrusions. At first the woodcutters took no notice but in November 1982, the tribals armed with bows and arrows fought a skirmish in which one person died. The matter is now in court. The forests are being guarded by the tribals. In the same area, PIPAR and a local youth group have planted 12 hectares of cashew on land leased from the forest department. The aim is to generate income for the people and demonstrate the benefits to neighbouring villages.

The National Institute for People's Development Investigation and Training (NIPDIT) is working with the people of a village who have 'adopted' 200 hectares of forest. All woodcutters are excluded from this forest and it is not to be used even by the villagers for the next 20 years except for fodder, leaves and twigs.

**Protection project**

The Friends Association for Rural Reconstruction (FARR) in Kalahandi,Orissa, has two major programmes concerning forests. The first is the protection of bamboo forests in a block in the Bolangir district. The villagers refuse to let anyone cut bamboo in this area. In certain villages of Bolangir and Kalahandi districts the villagers have started community forestry programmes on village lands with the help of FARR. In several places they have had to struggle to free the common village lots from the clutches of big landlords.

As a result of these skirmishes, the villagers rarely got cooperation from lower-level officials, though the senior ones gave instructions to their subordinates to cooperate. In one case, the government nursery gave the villagers only rejected saplings of fruit trees. Though they had asked for fruit and fodder saplings for 20 hectares, the forest department said that they had only teak saplings for 10 hectares.

In Chattisgarh in Madhya Pradesh, a Chattisgarh Vana Sangram Parishad has been formed with a massive tree plantation programme. Where there has been confrontation with the forest department, they too, do not receive any saplings from the government nursery.

Siir, a village about 80 km from Udaipur, Rajasthan, led by a Sarvodaya worker, Rameshwarji, has managed to get 400 bighas of land from the forest department. The perception that the trees belong to the village has ensured that only dried twigs and wood are sold or used as fuel. The villagers not only look after the few trees on the forest land but also take care of trees within the village. They stopped labourers who came to tap gum trees and summoned the contractor to their 'nyaya' panchayat. In another event, a case was even filed against the forest guard in the 'nyaya' panchayat.

**Community crusade**

Mass education about environment is another major activity of the non-government set-ups. Probably the most dramatic example is that of the students of the Intermediate Vanrajik College in Chandrapur, Maharashtra. Their work takes its cue from Rabindranath Tagore who on every 22nd of the month of Shravana would organise a big function in Shantiniketan. A small sapling, 'Baltaru', would be brought in a flower-bedecked palanquin and with great rejoicing taken out in a procession. Later the sapling would be lovingly planted. This tradition has been emulated by Baba Amte in his ashram.

Taking inspiration from Baba Amte, the Chandrapur students took out a 41-km padayatra from Chandrapur to Warora in 1979 with a palanquin carrying a sapling, the 'Baltaru', on their shoulders. The youth sang, shouted slogans and planted trees all the way. In 1980-81, NSS volunteers from a Vidarbha college also joined in the yatra. In November 1982, 1,500 students from 350 colleges belonging to seven different universities cycled all the way to Aurangabad to plant one lakh saplings.

In December 1983 this campaign took on an even bigger form: it became the "Vishal Madhya Bharat Vriksha Ganga" (Greater Central India Tree Ganga). Students from Chandrapur cycled 550 km to Bhopal taking with them the message of the importance of trees. Many village youth joined them on the way. In Bhopal, students from five Madhya Pradesh universities also joined them for a two-day rally and tree planting camp. The campaign organisers are thinking of bigger things for the future—which is just how it'll have to be if community forestry is to become a crusade.

# THE GREAT EUCALYPTUS DEBATE

The eucalyptus is one of the straightest trees in the world. But the debate on it has been far from straightforward. The tree is one of the hottest environmental issues in the country today.

Forest departments across the country seem to love the tree: nearly half a million hectares have been brought under this exotic species and 80 per cent of all seedlings distributed are eucalyptus. But with increasing vehemence, critics describe it as an "ecological monster" which drains the water table, depletes the soil, prevents all other plants from growing underneath it, and makes cultivation on neighbouring lands impossible.

In Karnataka, members of the Ryota Sangha (Farmers' Association) have even uprooted millions of eucalyptus seedlings planted on government lands in Tumkur district and in government nurseries. The powerful Sangha has warned the state government that it must stop planting eucalyptus. Convenor M.D. Nanjundaswamy told the press: "If the government does not accede to our demand, we need only two days to ensure that eucalyptus is wiped out of Karnataka."

In an article in the Economic and Political Weekly, in August 1983, writer Mahasveta Devi wrote: "I am concerned with the India I know. My India is of the poor, starving and helpless people. Most of them are landless ... To cover Porulia, Bankura, Midnapur, Singhbhum, Palamau with eucalyptus will rob my India of drinking and irrigation water ... An anti-eucalyptus movement on a national scale seems to be the only answer."

Also in August 1983, a team of environmentalists which included Sunderlal Bahuguna, former chief justice of Karnataka High Court, Chandra Shekhar and Professor B.V. Krishnamurthy, visited eucalyptus plantations around Marasandra in Hosakote taluk, about 30 km from Bangalore. Bahuguna declared afterwards: "I will not mind if a mass movement for pulling out eucalyptus seedlings and replacing them with some other useful tree species was started as I am personally convinced about the possible dangers of eucalyptus cultivation."

**Detailed observations**

The team told the press of their observations: "Leaves of eucalyptus that fall to the ground do not retain any moisture. The leaves group themselves into heaps and remain in a dry state whatever be the intensity of rainfall. There is no mulching; cattle,sheep and goats are not to be seen on these lands; and there are no dung droppings of any sort. As a result there is no decomposition of organic matter, vegetable or animal, no absorption of nutrients by the soils and no humus formation. The top soils are lifeless and the surface wears a hardened desert look. Nor is there any existence of microorganisms (plant or animal) beneath the top soils.

"The explanation offered is the exudation of toxic chemicals by the eucalyptus root system that destroy the microorganisms. In stands where the stub of the trunk has been in existence for more than 10 years, the spread of the root system is so huge that clearing of these roots structures in these lands for future land use is beyond economic feasibility. One can witness the dried up wells and tanks depleted of water all over the regions surrounding the eucalyptus stands.

"The local farmers narrate their personal experiences in this regard over the past 20 years. Ragi lands of private farmers adjoining the eucalyptus stand display a bare surface of some 30 feet to 50 feet width and thin vegetation over another 30 feet to 50 feet width. It is only at some 60 feet to 100 feet distance away from the eucalyptus border that one notices a reasonable crop cover over the fields. Desertification of top soils, chemical contamination of the fields, exhaustion of water resources all around, and the spread of root formation as the tree advances is of such

Eucalyptus plantations do little to hold or improve the soil. The species has been planted over nearly half a million hectares.

dimensions that these lands under eucalyptus have to be permanently abandoned. This is what one sees at Marasandra— permanent damage and destruction of the life supporting land and water resources base."

But the other side also makes its points. Private tree-farmers and foresters love the tree and consider it a god-sent gift which grows well in dry conditions, does not get browsed, coppices well, fetches a high price and stabilises incomes. Pro-eucalyptus environmentalists K. Ulhas Karanth states: "Claims such as that eucalyptus has caused a drought in Bengal, that these trees do not cast shadows and that thousands of livestock might go without a blade of grass to eat etc are all too fantastic to merit a rebuttal ..." The Gujarat forest department states: "Eucalyptus is an unmixed blessing for Gujarat farmers."

**Chequered career**

Eucalyptus reportedly made its appearance in India about a couple of centuries ago. In 1970, Tipu Sultan introduced about 16 species in Nandi hills of Kolar district. A few still survive. Out of 500 known eucalyptus species, 170 have been tried in India, and five planted on a large scale. The first large-scale plantation work was taken up with *Eucalyptus globulus* in 1856 in the Nilgiris. Eucalyptus hybrid or *Eucalyptus tereticornis*, popularly known as Mysore gum, has been the most widely planted species since the 1960s.

There have been several failures, for instance, in areas of high rainfall in Kerala and Assam. Here luxuriant natural forests were cut down to establish eucalyptus plantations but the trees did not thrive, severely attacked by a fungal disease. Madhya Pradesh planted about 46,000 hectares between 1956 and 1974, in ravinous areas of Bhind and Morena districts to promote soil and water conservation. The plants died in large numbers when their roots hit the impenetrable sub-soil kankar pan. After 1974, eucalyptus has been raised only in mixture with other fast growing species in the state. Between 1974 and 1982, 11,870 hectares of mixed eucalyptus plantations were established.

But the debate today really centres on the planting of eucalyptus in low rainfall areas and in degraded and marginal lands, especially now that thousands of farmers in such areas are planting eucalyptus in a big way. Karnataka's foresters, who too had felled natural forests in the Western Ghats for eucalyptus, now restrict its planting to lower rainfall zones of 500 mm to 1,125 mm. Says environmentalist B.V. Krishnamurti: "The depressing effect of drought on fields of rainfed crops (millets, pulses and oilseeds) coupled with the lack of remunerative price support for these crops, is driving the farmer to such frustration that opportunities offered by industrial interests for turning their lands into eucalyptus plantations are finding ready acceptance. And the forest department is encouraging the farmers to raise eucalyptus through the massive distribution of seedlings free of cost."

(Kannan Mehta)

**Spreading tree**

An official survey of Kolar district confirms these trends. In 1979–80, there were 4,828 hectares under eucalyptus and 4,688 hectares under casuarina in Kolar district. By 1982–83, the area under eucalyptus had almost trebled to 15,492 hectares while the area under casuarina dropped to 4,013 hectares. As much as 63.3 per cent of the area under farm forestry was earlier agricultural land, a detailed survey of five villages in the district revealed.

In the last three years, out of a total of 45.44 crore seedlings distributed in Gujarat, 32.72 crore have been eucalyptus. By 1983, there were some 40,700 hectares of eucalyptus plantations in the state. Since 1980, even good irrigated lands have come under high-yielding eucalyptus plantations.

In Punjab, the area under forests has increased from 4.25 per cent to 5.20 per cent of the total land area mainly because of the numerous private farms that have come under eucalyptus, and a eucalyptus rush is on, especially in the semi-arid areas of Hoshiarpur and Rupnagar districts. In 1984, the government plans to plant another 5,000 hectares with eucalyptus and private farmers will add another 3,000 hectares.

In Haryana, nearly 40,000 hectares of crop land is under eucalyptus, especially in the rainfed areas of Ambala, Karnal and Kurukshetra. Some 150,000 hectares of eucalyptus plantations exist in Maharashtra in combination with other species, of which some 25,000 hectares are irrigated. In Uttar Pradesh eucalyptus covered 82,000 hectares by 1979. Karnataka has planted about 1,33,000 hectares, with many farmers taking to it in Kolar and Tumkur districts. West Bengal and Tamil Nadu are also joining the eucalyptus wagon.

Many farmers have become hardened eucalyptus cultivators. D.N. Mishra, a senior forester from Uttar Pradesh, claims that "in this state we even insist that 10 per cent of plantations should comprise of species other than eucalyptus. But farmers in western Uttar Pradesh want only eucalyptus". Shyamsundar, chief conservator of forests in Karnataka also points out: "Last year some 5 million seedlings (of other species) were wasted in our nurseries due to lack of demand."

### Intensive farming

In Bhavnagar district, in just one year more than 9,000 farmers have planted more than 10 million eucalyptus trees. They are led by a civil engineer-turned-farmer, Dr V.J. Patel, who is advocating high density irrigated tree planting, a new technique in which 25,000 trees are packed into a hectare at a spacing of less than 60 cm x 60 cm, which gives six to 10 times more trees than the conventional method. He has been getting 90 per cent survival and an average of 15 kg per tree. Twelve kg is saleable timber—as 3 kg biomass is left behind as unsaleable.

Patel starts cutting one-third of the best trees in the fourth year, one third in the fifth and another one third in the sixth. Including a 12.5 per cent interest on his capital, his expenditure comes to Rs 25,000 over six years, and his income — at the rate of Rs 16.40 per tree — comes to Rs 1,47,000, a profit of about Rs 50,000 per hectare per year. This makes eucalyptus more profitable than even the best cash crops like cotton.

Patel believes his plantations will last 30 years and he will get some six or seven coppices. Many foresters are worried about the health of the soil under such intensive cultivation. Patel argues that eucalyptus leaf litter builds up rapidly in the soil, decaying quickly as little sunlight reaches it because of the heavy shade, and thus enriches the soil. Moreover, he argues, now that he has stopped growing cotton, the threat of waterlogging from over irrigation has disappeared.

Farmers like Patel would even like to see the government set up wood-based electricity stations, so that demand for wood is maintained and farmers do not have to resort to distress sales. According to him, prosopis grown on the wastelands of Bhavnagar could sustain a 150 mw thermal power plant. The government of Gujarat has already initiated a 1.5 mw experimental dendrothermal power project at the Dantiwada campus of Gujarat Agricultural University.

### Dramatic success

Small farmers too are interested in eucalyptus farming, as can be dramatically seen in Mallewal village in Hoshiarpur district in the foothills of the Siwaliks. Some 118 small and marginal farmers in the village have taken to eucalyptus farming over 45 acres. This village has had five successive crop failures. Even when the rains come, the water disappears quickly in the sandy soil. The land is infested with termites, and as income from agriculture is insufficient, most of the men migrate periodically to industrial towns or surrounding market towns to work as labourers.

Mallewal is the home village of Dr D.R. Bhumbla, former agriculture commissioner and currently executive director of the Society for Promotion of Wastelands Development (SPWD) in New Delhi. Dr Bhumbla suggested that farmers plant trees and that SPWD could help them if they were prepared to dig pits. The SPWD could supply only about 45,000 seedlings to meet the extraordinary demand.

At a spacing of 2m x 2m, one acre of land can take about 1,000 trees. The farmers expect to sell each tree for about Rs 100 after seven years. With even 50 per cent mortality, they can hope to earn an equivalent of about Rs 600 per month for the next seven years from an acre of eucalyptus, an income which no crop can match. When asked whether the farmers would use the wood as firewood, they retorted, "Do you want us to burn our currency notes?" There is a catch: under the Punjab Cho Prevention Act of 1903 no tree can be cut without the permission of the forest department and farmers could lose a quarter of their income in bribes getting permission to fell the trees.

## Review panel

In response to the growing criticism, the Economic and Planning Council of Karnataka (EPCK) at the request of Chief Minister Ramkrishna Hegde held a meeting in September 1983 to which eucalyptus critics like Dr J. Bandyopadhyay of the Indian Institute of Management in Bangalore and Professor B.V. Krishnamurthy and various ecologists and foresters were invited. The panel did not review the ecological effects of eucalyptus plantations as monocultures, restricting itself only to effects of eucalyptus as a species. Bandyopadhyay later dismissed the report as "a highly misleading document" and "a cunning way to confuse farmers".

The report of the panel meeting prepared by former Planning Commission member G.V.K. Rao points out that whether eucalyptus hybrid leads to an increase in water runoff and soil loss depends upon what it is replacing. The report states that if eucalyptus hybrid is replacing a natural stratified forest then the water runoff and soil loss will be increased. If, on the other hand, eucalyptus hybrid is planted in agricultural land or degraded land devoid of tree cover— as envisaged in the government plans— then the water runoff and soil loss will decrease.

### Effect on water resources

On the heavy consumption of water by eucalyptus plantations, A.N. Chaturvedi, a senior forester of Uttar Pradesh says that "in any area the same number of eucalyptus trees will consume more water than any other species during the same period." R.K. Gupta of the Central Soil and Water Conservation Research Centre in Dehra Dun points out that in low rainfall areas, eucalyptus roots form a dense network just below the soil surface to extract every bit of moisture. The EPCK report also agrees that eucalyptus plantations are heavy consumers of water on a per hectare basis. But it argues that "one has to look at the total water balance including the impact of transpiration losses and the extent of percolation into the soil".

As far as the possibility of eucalyptus plantations lowering the ground water table is concerned, the EPCK report argues that the roots of eucalyptus hybrid rarely go lower than 3 metres to 4 metres deep and usually do not spread out (laterally) more than 1.5 metres. This means that eucalyptus hybrid only consumes subsurface seepage water, and it cannot tap subterranean groundwater. This being so it is unlikely that eucalyptus hybrid is responsible for wells running dry. This phenomenon can be due to several other factors such as: enormous increase in the number of irrigation pumpsets; continuous drought for two consecutive years; and very high density of tree planting. In Davanahalli and Hoskote taluks, for instance the number of energised irrigation wells had doubled within six years. Similar intensity of exploiting underground water is visible in several parts of Kolar district. A.N. Chaturvedi argues that the Terai region of Uttar Pradesh, where eucalyptus plantations have also reportedly lowered the water table, is full of tubewells.

In a letter to 'The Hindu' in September 1983, R.M. Ray of the Eucalyptus Research Centre at Coonoor says that it is a fact that streams have dried up in Nilgiris after the removal of the original 'shola' forests, "but it is uncharitable to blame it on eucalyptus. The eucalyptus plantations would have helped in recuperating the subsoil water had the leaf litter been allowed to remain on the ground and get converted into humus. But all the leaves are removed for distilling eucalyptus oil. In the plains, the local people remove the leaves and twigs for cooking purposes. In such a situation the soil is not in a position to absorb water and recuperate the water table."

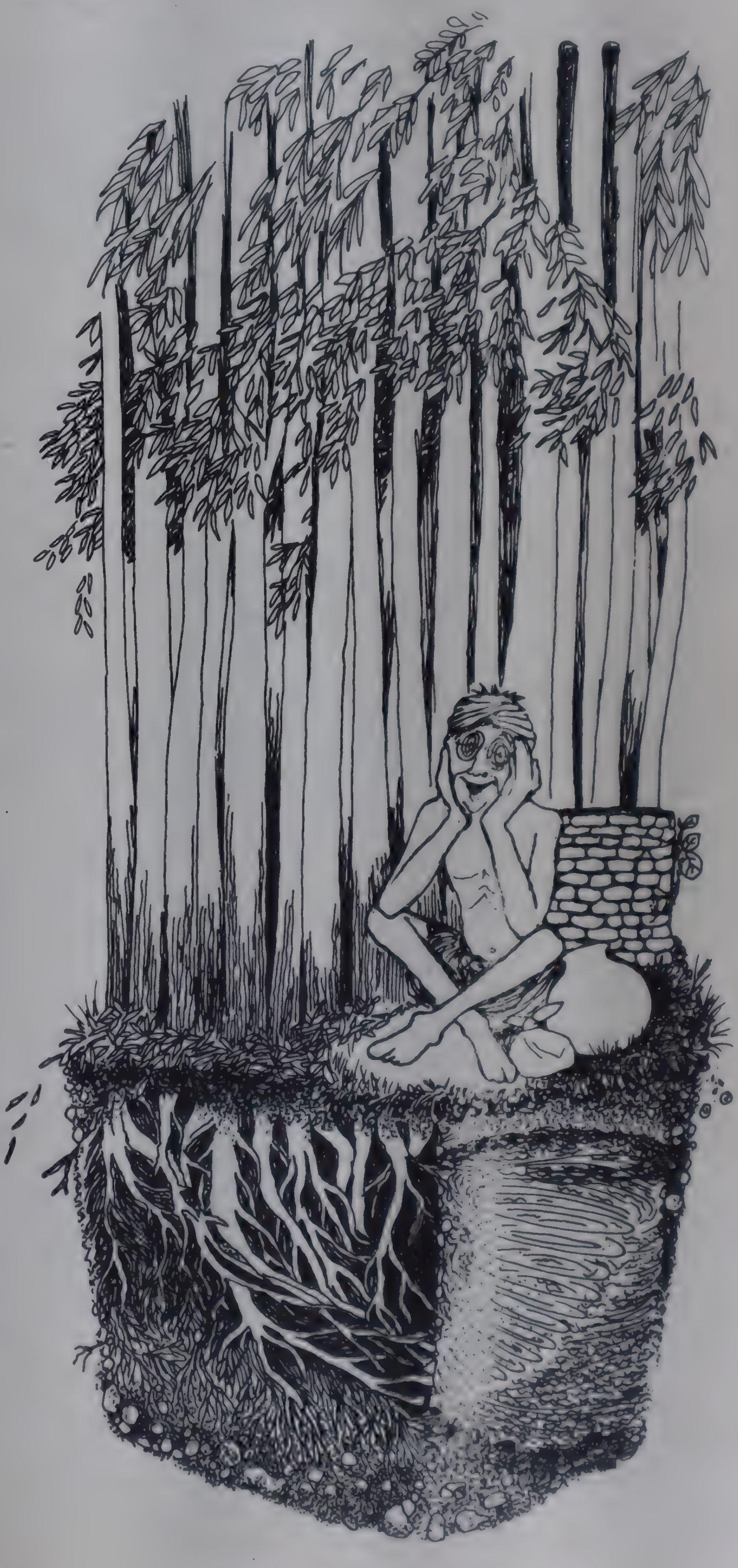
Foresters repeatedly cite a 1972 study from the Nilgiris which reports that the annual transpiration of water in a *Eucalyptus globulus* plantation corresponds to a rainfall of 34.75 cm whereas potato fields use 65 cm of rainfall. The total rainfall in the area was 130 cm, thus making available the balance 95.25 cm to cover interception loss, surface runoff, evaporation, deep percolation, water yield and soil moisture storage. H.N. Mathur of the Forest Research Institute in Dehra Dun argues: "It is agriculture crops which are responsible for depletion of water resources and not eucalyptus plantations. Water use for some of the agricultural crops like wheat, paddy, sugarcane and jowar is 38 cm, 104cm, 163 cm and 64 cm respectively." Kalidas Patel, one of the first eucalyptus farmers of Gujarat, switched over to eucalyptus because there was not enough water to grow cotton, which is a heavy user of water. Now that he has been farming eucalyptus, he claims, the water table in the region has stabilised.

Patel also claims that the plantation has improved the water absorption capacity of the land as compared to neighbouring farms because eucalyptus roots break the soil and thus increase the seepage. One night in 1976 water accumulated from 12 inches of rainfall was absorbed within one hour on Patel's eucalyptus farm. On the contrary, the water on some of the neighbouring farms stood for three to four days after the rain.

Bandyopadhyay, however, points out that the widely grown species of eucalyptus hybrid is totally inappropriate for semi-arid water short areas. Bandyopadhyay quotes several documents to show the eucalyptus hybrid is generally found in the eastern coast of Australia, which receives 700–1200 mm rainfall. A UNESCO publication also points out that eucalyptus hybrid needs 1200 mm of rainfall. In low rainfall regions, eucalyptus satisfies its heavy water demand by spreading out a vast network of lateral roots, which sometimes spread up to 13 metres, claims Bandyopadhyay. These roots compete for soil moisture and almost all undergrowth is prevented, except in irrigated conditions.

"Eucalyptus does not affect water resources merely by its demand on them," further says Bandyopadhyay. Eucalyptus trees intercept little rainfall, thus, allowing rain water to erode the soil by direct impingement. A study carried out by the Soil and Water Conservation Research Institute in Ooty found that interception loss in eucalyptus plantations was only 2.9 per cent. In acacia trees, it was 21.5 per cent and in native shola forests 33.8 per cent. "As a result of this low interception, runoff and soil loss increases with eucalyptus," argues Bandyopadhyay.

Thus, available studies show that the effect of eucalyptus on the total water balance of an area depends on a number of factors. But no water balance studies have been carried out with different types of eucalyptus plantations in different ecoclimatic situations. As forestry research is under the control of the forest departments, it is the government's responsibility to undertake this research and find the right answers. Foresters unfortunately have acquired such a vested interest in eucalyptus, that they have simply given up their responsibility to undertake relevant research, even if it be disquieting for government programmes.



### Soil strengths

The effect of eucalyptus plantations on the soil is a much more clear-cut issue. The EPCK report notes that the question of whether eucalyptus hybrid enriches the soil also depends on what eucalyptus hybrid replaces and on the planting density for eucalyptus. "If eucalyptus hybrid replaces a tropical rain forest, then it will return less nutrients to the soil than the rain forest. But eucalyptus will enrich the soil in the case of marginal agricultural land or unwooded or degraded areas".

"The impact of eucalyptus hybrid on the soil depends on the planting density. It appears that if the planting density increases above 10,000 trees per hectare, nitrogen and phosphorus deficiency may result. Karnataka is going in for about 3,000 trees per hectare and at these low densities, there is no evidence that eucalyptus depletes the soil. Indeed, by withdrawing the nutrients from the lower levels in the soil and depositing them on the surface, the nutrient status of the top soil is enhanced in eucalyptus plantations. To sum up, although natural forests should not be replaced with eucalyptus hybrid monoculture, there are no compelling and perceived grounds for discouraging eucalyptus cultivation in marginal agricultural or degraded lands, from the viewpoint of nutritional adequacy."

But the EPCK report may be overoptimistic, or even factually wrong, if proper management practices in eucalyptus plantations are not adopted. Quick rotations of eucalyptus will definitely affect the nutrient levels in the soil. Chaturvedi points out in his publication 'Eucalyptus for Farming' that there are genuine cases of 'second rotation decline'. He says: "Eucalyptus grow fast and are generally harvested at short rotations in commercial farming. Their demand for moisture and nutrients is, therefore, heavy. Recycling of nutrients cannot keep pace with felling in such cases. It may, therefore, be necessary to rotate eucalyptus with other species. These species should be nitrogen fixing, shallow-rooted and deciduous. Research for the choice of such species and their cycle of planting is needed."

The tree begins to recycle nutrients at an accelerated pace only after its growth has reached its peak. But to get a good economic return, eucalyptus should be felled in only eight to 10 years. Eucalyptus plantations raised by farmers in Kolar district have a rotation cycle of only three to five years. When plantations of fast-growing species are harvested at short rotations they deplete the soil of certain micronutrients, from varying soil depths, says Chaturvedi. Soil fertility will be depleted without proper management and four to five coppices will not be possible. In Haryana, Punjab and the Terai region of Uttar Pradesh a decline in productivity has in fact been noted in the second coppices, which show pronounced symptoms of chlorosis (yellowing of leaves). In short, eucalyptus plantations do not constitute sustainable forestry. If ever wood prices fall, or for any other reason eucalyptus forests have be converted back into agricultural lands, farmers will find their soil heavily depleted of nutrients.

### Fertiliser use

Several farmers in Gujarat are using chemical fertilisers in their irrigated eucalyptus plantations. But chemical fertilisers should be used with great care, warns Chaturvedi. "High yields of eucalyptus are generally associated with increased application of inorganic fertilisers and irrigation," he says. But "excessive use of chemical fertilisers may cause lasting damage to soil and trees. In case of eucalyptus in India very little is known about the uptake of fertilisers. Any fertiliser not utilised by plants may increase their percentage in soil and may eventually make the soils sick. Unregulated use of inorganic fertilisers may, in the long run, be harmful for the growth of eucalyptus or even other species."

The use of chemical fertilisers even in forestry raises major questions for the country, none of which have been seriously addressed by Indian planners or experts. Firstly, the country will have to be prepared to produce enormous quantities of fertilisers or import them, if so necessary, at enormous economic cost. Secondly, water pollution problems will become extremely severe and will be accompanied with major changes in aquatic ecology. The World Bank's chief adviser on forestry admits the need for additional fertilisers. But the complacency with which he dismisses this problem should definitely not be shared by planners and experts in a developing country like India.

The EPCK panel agreed with eucalyptus critics that eucalyptus hybrid affects the pH of the soil and turns it acidic. But it argued that "this is a blessing for alkaline soils. In a particular experiment the pH of an alkaline soil in an eucalyptus hybrid plantation decreased from 8.2 to 8.0 in 11 years. In other words, eucalyptus hybrid actually improved the soil. In Karnataka most of the soils are alkaline and therefore, the acidic character will not prove a problem. The impact of eucalyptus hybird cultivation on mildly acidic soils is also unlikely to be seriously damaging though it would be wise to discourage eucalyptus cultivation on highly acidic soils."

The available information on whether eucalyptus prevents undergrowth is again contradictory. While R.K. Gupta of the Central Soil and Water Conservation Research Centre at Dehra Dun points out that the heavy demand for water by eucalyptus prevents undergrowth. The EPCK panel report notes that again much depends upon what eucalyptus hybrid replaces and what planting density is adopted: "Compared to natural forests, the undergrowth under eucalyptus would be far less. But if eucalyptus is grown in degraded and unwooded lands, undergrowth can occur provided the planting densities are low and of the order of a few thousand per hectare. Typically, there are other reasons for the absence of undergrowth such as excessive grazing, fires, fuelwood collection and soil erosion."

### Undergrowth development

Forest departments argue eucalyptus does not prevent undergrowth. A note prepared by the development wing of the Forest Department of Karnataka claims: "Where rainfall and soil conditions are better, profuse regeneration of native trees, shrubs and grasses can be seen inside eucalyptus plantations. The lack of undergrowth in the arid areas is on account of already degraded soil, overgrazing, and removal of the leaf litter by the villagers."

According to B.K.C. Rajan of the University of Agricultural Sciences, Hebbal, the lateral roots of eucalyptus hybrid ramify and occupy the top soil up to about 20 cm from the ground surface. Certain grasses grow well under eucalyptus plantations. A study by the Central Arid Zone Research Institute at Jodhpur points out that eucalyptus plants exploit subsurface moisture for their

## Danger! Red Tape

There is many a slip between a good idea and its implementation. Nowhere is this illustrated than in social forestry, ostensibly designed to help the poorest. One of the blocks seems to be an understanding gap between social forestry officials and the villagers they try to help. The officials consider suggestions from villagers, based on a much deeper and sounder knowledge of their own ecosystems, unviable, while villagers are unnecessarily obsequious to bureaucrats and will not question or insist on their rights. The following two examples are by no means isolated incidents.

The Ahmedabad Study Action Group (ASAG) and the Mahiti project started work in the Dhanduka taluk of Gujarat in 1979-80 with the object of generating employment for families living below the poverty line. This taluk is economically underdeveloped: agriculture is possible only during the short rainy season and for eight to 10 months of the year, most of its 200,000 people migrate out of the taluk. There is little groundwater, the soil is alkaline and saline and there is considerable soil erosion, waterlogging and monsoon flooding of rivers and streams.

Conversations with the villagers revealed that a variety of trees had previously grown in the area; these helped leach salt from the soil and made it suitable for crop cultivation. The most common was Prosopis, locally called "Ganda Baval", meaning "the crazy one" because it grew anywhere. It was used for both fuelwood and fodder. Another traditional species which had disappeared was the Salvadora from which a non-edible oil extract could be obtained.

Mahiti workers suggested to forest officials that they attempt reintroduction of these species. The response was sceptical Mahiti workers and villagers then decided to reintroduce these species on their own. And planted five species in 1981. The survival rates of these plantations were 100 per cent compared to 60 per cent to 70 per cent of those that followed set ideas generated by officials. Only after this experiment did the forest department start a nursery in an adjacent area and propose schemes for the development of village forestry and roadside plantations.

Another example comes from Ghantali village in Rajasthan. In November 1981 the Rajasthan government decided to support social forestry programmes to be implemented by voluntary agencies. Ghantali was one of the pilot areas and here, an organisation of local tribals called the Gramin Vikas Samiti decided to raise 20,000 saplings in the summer of 1982 and sell them to the local forest department. After a lot of persuasion, three tribal farmers, Heera, Mangla and Meti, agreed to grow 5,000, 5,000 and 10,000 saplings respectively if the forest department gave them an advance. Each sapling cost 40 paise—20 paise for labour and 20 paise for inputs such as seed, polythene bags and fertiliser. The district forest department undertook to supply all the inputs and pay the farmers 20 paise per plant just before the monsoon.

The Gramin Vikas Samiti proposed that 10 paise per sapling be given in advance but officials feared that this might set a precedent. It was important that local tribals get an advance because most of them migrate on a seasonal basis in search for work. These people could not wait till the seedlings were ready. Finally, it was decided that, as a special case, the three farmers would get 5 paise per sapling, in advance, but the money reached them only in late May 1982, well into the summer.

There were other holdups. The bags and seeds arrived only by March. Then, the forest guard who was supposed to guide the villagers played truant and the villagers' efforts were saved from disaster by the chance visit of a voluntary worker from 70 km away, who explained that the polythene bags had to have holes punched in their sides.

There was confusion when the saplings were distributed. The three farmers wanted their fields free before the monsoon—they wanted to plant maize and also feared that the river would flood and ruin their saplings. But, the forest guards took time to count the plants—an exact count was necessary for payment—and said that they alone could distribute them as they had to note down every donor. Then there was a great demand for bamboo saplings but none for khair. Finally every bamboo sapling was given with two khair.

The saplings were not distributed in time and the three tribals were unable to sow the main monsoon crop on half their field covered by the tree nursery. Even in September 1982 about 2,000 khair saplings were lying undistributed.

Although the project was a success after all, the full quota of saplings raised and distributed, the farmers paid in full though late, there are several ecological questions that remain. For instance, the project robbed farmers' fields of precious topsoil which was put into polythene bags for the seedlings. Another lesson is that without the intervention of the voluntary worker, Heera, Mangla and Moti would have been deep in debt. On their own they would not have been able to tackle officialdom—the red tape that can so easily strangle this new green revolution.

growth, leaving the surface moisture for undergrowth or other short duration crops. Another study reports that in areas which had only a coarse grass cover prior to planting of eucalyptus, the ground cover gradually changed to evergreen species.

But Rajan also points out that since lateral roots of eucalyptus hybrid and their ramifications occupy a large portion of the top layer of soil, some species cannot compete with its root system. *Leucaena* remains stunted if grown near old eucalyptus hybrid trees.

Mixed eucalyptus plantations have also not fared well. According to Chaturvedi, the most profitable way of handling eucalyptus plantations is in monoculture. "Eucalyptus plantations have been raised in mixture with teak, *Casuarina equiesetifolia, Anacardium occidentale, Allanthus malabaricum, Bombax ceiba, Evodia roxburghiana, Grevellia robusta, Santalum album, Albizzia lebek, Acacia arabica*, etc. The experience of these mixed plantation trials shows that these are not successful. Suppression inevitably occurs in one or the other crop and eucalyptus suffer more from competition."

### Important role

Dinesh Kumar of the Indian Agricultural Research Institute in New Delhi, however, argues that eucalyptus plantations have a definite role to play in agroforestry systems. Eucalyptus plantations in the midst of farmlands act as windbreaks, increase humidity and cut down radiation to increase photosynthetic activity in nearby agricultural crops. These advantages have resulted in 23 per cent and 24 per cent increase in yields of wheat and mustard respectively in Gujarat and 40 per cent to 43 per cent, 39 per cent to 47 per cent and 23 per cent to 64 per cent increases in yields of groundnuts, arhar and bajra respectively in Andhra Pradesh. In Gujarat, where irrigated farm forestry is progressing in a big way many farmers have started taking intercrops with eucalyptus. Kalidas Patel is experimenting with the possibility of taking grain and pulse crops. He already grows two species of fodder grasses.

But there are others who disagree that eucalyptus has good effects when planted along fields. Dr U.S. Kang, a farmer and a member of the Punjab Planning Board claims that many farmers have stopped growing eucalyptus along field boundaries because it depletes water on both sides of the bunds. Moreover, he had found in his personal experience that eucalyptus attracts crows which then damage grain crops. Kang recommends that a legume like leucaena must be planted in between eucalyptus to preserve soil fertility. Bhumbla argues: "it must be pretty bad agriculture to begin with which gives a 24 per cent increase in yield of wheat simply by planting eucalyptus along field boundaries."

The broad government opinion today— backed by the opinion of government scientists— is that eucalyptus should continue to be planted in suitable, marginal and degraded areas, if the country's growing wood needs are to be met. Dr T.N. Khoshoo, secretary to the Department of Environment, told the National Seminar on Eucalyptus which was held in Peechi, Kerala in January '84, clearly: "Eucalyptus can be a blessing in a captive plantation . . . . eucalyptus plantation can be grown successfully on marginal or degraded land without any major disadvantage." The EPCK report even goes on to say that if eucalyptus plantations under social forestry replace agricultural crops in drought-prone areas to a limited extent, that would be ecologically beneficial.

There is, however, growing government concern about farmers putting irrigated land under eucalyptus farming. The EPCK report warns: "Good quality canal irrigated agricultural land should not be encouraged to be brought under tree farming." Bhumbla points out: "The shift to tree farming in irrigated areas is likely to affect foodgrain production very adversely. Growing of trees in one million hectares in Punjab/Haryana will lead to the loss of 6 million tonnes of foodgrains." Some experts even talk of legislation to prevent irrigated lands going under eucalyptus.

But none of these experts and expert groups address themselves to the problem of short rotation plantations of eucalyptus or any other fast growing trees for quick profit, as is being undertaken by many farmers and forest departments and proposed by the paper industry on a large scale, draining the soil nutrients and creating an enormous dependence on inorganic fertilisers, leading also to high levels of water pollution. How will the government ensure that farmers will give primacy to the fertility of the soil, and the interests of future generations, over their pockets? Micronutrient deficiency is already emerging in a big way in intensively cropped areas. Khoshoo himself admits: "From a perusal of the EPCK document, it is clear that there is a need for more scientific data to draw up parameters regarding the type of land and other inputs necessary to raise eucalyptus plantations successfully."

### Scanty data

At a meeting held by the Planning Commission, Bhumbla raised probably the most pertinent issue with respect to eucalyptus: does it actually out-yield all other trees in all situations? Bhumbla said: "There is no data to show that eucalyptus produces more biomass than indigenous species like *Acacia nilotica* or *Dalbergia sissoo*. Foresters just measure the trunk but not the total biomass. There is too much bias— and vested interest— in coming to the conclusion that eucalyptus is better. We need a lot of data on production of eucalyptus in different ecoclimatic and soil situations. We don't have that data."

Bhumbla said the incessant government propaganda in favour of eucalyptus is taking the poor farmers for a ride. Because of all the propaganda, people now want to plant only eucalyptus. In his own village Mallewal, Bhumbla's warnings against eucalyptus went unheeded. "You will plant eucalyptus but you will harvest *Acacia nilotica,*" he told them, and truly, the growth of eucalyptus to the farmer's dismay has turned out to be poor.

Dr. M.P. Gupta of Himachal Pradesh Forest Development Corporation (HPFDC) too complained that despite all the money spent on eucalyptus plantations, "knowledge of eucalyptus is still ad hoc". "As a forester, I am sceptical about exotics. We have found Chir and Kail *(Acacia catechu)* as fast growing," he told the Planning Commission. It is indeed a fact that even less is known in India about indigenous species than about eucalyptus. Probably no programme in the world has been taken up for ecological restoration and for meeting people's needs in greater ignorance of both ecology and local needs.

**Over 100,000 Gujarati farmers have planted eucalyptus on private lands. A farm labourer removes bark to make poles. (F. Botts/FAO)**

## Political arguments

Critics of eucalyptus point out that their criticism is not restricted to its ecological effects. In an angry rejoinder to K. Ulhas Karanth titled 'Against Eucalyptus', writer Claude Alvares states: "Our principal objections to eucalyptus are not however ecological, even though the ecological position is devastating as it is, but political."

The decision to plant eucalyptus in the existing socio-economic situation marked by extremely high prices for wood in urban areas and in industries and an acute shortage of fuel and fodder faced by poor rural populations who cannot afford to purchase anything, displays a clear choice in favour of earning a quick buck by meeting the needs of the rich in society and not the rural poor. It is not surprising that whenever rural women have been organised to plant trees, in almost all those few cases their choice has been in favour of mixed plantations of fruit, fuel and fodder species.

Tree farmers and foresters repeatedly point out that they favour eucalyptus over other species because it cannot be browsed. But it is ironic that a species which cannot be browsed is being planted on such a large scale when the fodder shortage may be even more acute than the fuel shortage, and production of fodder was, in fact, one of the primary reasons for the National Commission on Agriculture to recommend social forestry programmes in 1976. Yet social forestry programmes riding on the eucalyptus wave have today totally turned their back on fodder production.

Manibhai Desai of Bharatiya Agro-Industries Foundation at Urulikanchan, who has extensively planted leucaena which provides excellent fodder, dismisses the argument that farmers must use non-browsable species. "After all, almost all agricultural crops can be browsed, and farmers do protect them." Ecodevelopment camps in Uttarakhand also show that when people want to protect trees, they can.

The major problem is that the forest bureaucracy cannot plant browsable species and guard them with much success. "The campaign against eucalyptus will put an end to the forest departments' afforestation efforts," says one observer. "The forest bureaucrats cannot put in the same effort to protect trees that the people can. If they are not allowed to plant eucalyptus their mortality rates will be too high."

### Firewood needs

It is a moot question whether eucalyptus plantations provide much firewood, especially when many paper industries are prepared to purchase pulpwood almost at the farmers' doorsteps. Karanth and Mewa Singh in their pro-eucalyptus article in the Deccan Herald entitled 'Barking up the wrong tree', also agree: "We must in the end confess that there is a major problem associated with eucalyptus in Karnataka. This is not a problem of forestry but a political one. The government is producing over 100,000 tonnes of eucalyptus wood annually from public plantations. There is a crying need for firewood and small timber all over the state. Logically eucalyptus wood which belong to the people should be harvested and sold to the people to meet their basic needs, if necessary at concessional prices. On the contrary we find that all the state governments which have been in power so far, including the present Janata government, are diverting all eucalyptus plantations to Harihar Polyfibres (a Birla group company) and other industrial units. Unless the government takes a principled stand and channelises the entire eucalyptus wood annually from public plantations to the non-industrial consumers, the pressure on natural forests will increase .... The environmentalists should unitedly articulate this demand rather than argue for the abolition of a tree called eucalyptus hybrid"

When pushed into a corner, some foresters plead helplessness in the face of politicians. Says Y.M.L. Sharma, a retired forester from Karnataka: "People do not understand what pressures the forest departments are subject to. The government and politicians promise the industry a fixed amount of wood and we are called upon to do the job. What else can we do but plant trees like eucalyptus?"

Shyamsundar, Karnataka's chief conservator of forests, claims that "for the present we are trying to divert wood from the industries to the people". Karnataka today has a firewood demand of 4 million tonnes, of which only 0.6 million tonnes is provided by the forest department. The rest comes as headloads.

Foresters and eucalyptus farmers repeatedly argue that only the trunk goes to the industrial market and as much as 40 per cent of the wood is left behind as the lops and tops for the local people to use. But with rising prices of firewood in energy-starved towns and cities, it is unlikely that even this biomass will be left behind for the rural poor. Indeed, with the prices of firewood in towns now matching pulpwood prices, the Uttar Pradesh forest department has begun to sell eucalyptus wood as firewood. Firewood available in recent years in towns of Kumaon region, for instance, is from eucalyptus. The market rates of both pulpwood and firewood with bark from eucalyptus fixed by the Uttar Pradesh Forest Corporation for April 1983 was Rs 330 per tonne.

### Energy crisis

There is strong reason to believe that eucalyptus plantations could worsen the energy crisis for the really energy-starved in the rural areas. Energy scarcity afflicts mostly those who do not have adequate land, to obtain crop wastes or trees, or any cattle, to obtain their own cowdung. These people are also too poor to purchase kerosene to cook.

In other words, it is the landless peasants and small and marginal farmers who really suffer from energy scarcity. These people have to depend on either public lands (forest or roadside vegetation) or on other farmers, who have surplus crop wastes or cattle, to meet their daily energy needs. Though the quality of available data is poor, the latest report by the National Council of Applied Economic Research shows that the proportion of those families which have to collect their energy from others' lands is growing in northern India for which past data is available. There is no reason to believe this is not happening in southern India also.

Now browsable weeds like lantana and parthenium, which have spread across the country on degraded public lands, are being used extensively for fuel purposes by poor people. Thus, even if degraded public lands with nothing but seasonal weeds growing on them are converted to eucalyptus plantations, the energy crisis of the poor will be immediately intensified. It is not surprising that foresters regularly report the collecting of dry eucalyptus leaves for fuel by poor people, even though it is surely not a choice fuel. Similarly, if a big farmer turns over extensive crop lands to eucalyptus, the landless poor in the village who would earlier collect the farmer's surplus crop wastes for fuel would be deprived of it.

**Adverse effect**

The effect of eucalyptus plantations on tribal populations is even worse. Citing the case of Kerala where eucalyptus plantations have been raised after clearfelling natural forests, T. Madhava Menon of the Kerala Agricultural University at Vellanikkara points out that as a result "the circuit of land available for shifting cultivation is shortened and its fertility status is reduced. Their reservoir of wild roots and tubers in the natural forests is destroyed. Their articles of necessity like thatching grass and firewood are no longer available. What little husbandry they practised is also rendered impossible. The tribal population does not also benefit from the increased demand for labour for raising the plantations as usually, outside labour is preferred by the contractors. The eucalyptus plantations do not add to the availability of produce for tribal needs as it is aimed at industrial demand or marketability in the plains." Even the National Conference on Eucalyptus in Kerala, accepted the recommendation that "in future, before introducing eucalyptus in tribal areas, a careful impact-study on the welfare of the tribal population should be undertaken".

Members of the Ryota Sangha in Karnataka, who uprooted eucalyptus seedlings, raise some fundamental issues about the nature of socially desirable plants. They want decentralised economic growth and village self-reliance to be promoted through any biomass production. They argue that eucalyptus only binds them to a big industrialist. It does not provide anything to encourage local industry. Eucalyptus plantations fail to generate employment, involve women in income generation and, most of all promote absentee landlordism.

The Ryota Sangha had launched an agitation against eucalyptus in Yelagoonda village of Hasan district in 1982. There some 600 acres of forest land were being planted by the forest department with eucalyptus. This incensed the local people who had earlier obtained fuel and fodder from this land. The marginal and landless peasants uprooted the planted saplings. The police intervened but after further discussions, the land was distributed to 600 landless and marginal families, who are now growing tamarind and jackfruit trees as part of a social forestry programme and also cultivating ragi. The Ryota Sangha has plans for village cooperative society to set up a small industry using the produce from these trees. "Eucalyptus is not just a socially irrevelant tree but it is also now competing with the people for land," say Manjunath Dutta and Hanumanthegowda of the Ryota Sangha.

At the heart of the eucalyptus debate is the worsening public image of the forest bureaucracies who have now widely come to be seen as anti-people and as essentially pulpwood producing departments which have adversely affected tribals and other users of minor forest produce. Now even the limited scientific data they produce is doubted. The strong insistence of foresters that they alone have the knowledge and right to manage forests has only helped to alienate many environmentalists. There is no doubt that the great eucalyptus debate will continue for some years, generating a horde of arguments and a lot of heat.

**Eucalyptus yields little firewood or fodder. Chidren spend hours helping their parents to collect firewood. (Smitu Kothari)**

## GOVERNMENT FOREST LANDS

Attention in the last two years has mostly focussed on social forestry programmes, programmes mainly promoted on private farmers' and panchayat lands. Little public attention has focussed on the management of 75 million hectares of forest lands under the control of the forest departments. Inside government committees, the paper industry, facing an unprecedented raw materials crisis, is arguing for control over large tracts of degraded forest lands which it claims it could afforest and generate its own raw materials. Until now the industry has only dipped into the vast natural forests, in most cases at throwaway prices and caused massive deforestation, often in collusion with forest officials and money-hungry politicians.

Paper is a vital commodity. The per capita consumption of paper—often regarded as an index of literacy and standard of living—is around 2 kg per person per year, a pitiful amount when compared to the 268 kg in the US, 124 kg in the UK and 115 kg in France and even the 11 kg in Thailand and 10 kg in Egypt. The paper industry in India has steadily increased its capacity from 0.14 million tonnes in 1951 to 2.16 million tonnes at the beginning of 1983. There were then a total of 179 paper mills. About 20 per cent of the present paper-making capacity was in existence before the 1950s. Another 50 per cent came into existence between 1950 and 1970. The remaining 30 per cent was added during the 1970s. This period was marked by a drastic reduction in the growth rate compared to the 1950–70 period. The capacity added during the 1970s mainly came through schemes involving addition of balancing equipments in large mills and through the proliferation of small mills based on agricultural residues.

The Indian paper industry, like the Chinese, is unique for its wide range of mill sizes. Mill capacities range from 5 tonnes to 10 tonnes per day in the smallest units to about 250 tonnes per day in the largest mill. The latest newsprint mills are of 300 tonnes per day capacity. But even though there are many small paper mills in the country, about 65 per cent of the total installed capacity is represented by the large integrated mills with plant sizes of over 20,000 tonnes per year, which are only 16 per cent of the total number of mills in the country.

The growth of large mills was greatly inhibited during the 1970s because of steeply escalating energy and investment costs and even more because of growing shortages of raw materials like bamboo. A "redeeming feature" of the paper industry during the 1970s, according to the Development Council of the Pulp and Paper and Allied Industry (DCPPAI) constituted by the government, was the emergence of many small paper mills with an annual capacity of less than 10,000 tonnes based on unconventional materials like agricultural residues (rice and wheat straw etc), cotton rags, hemp, jute cuttings, and grass. Most capacities created in the past decade are based on agricultural residues, helped by tax concessions offered by the government for use of unconventional raw materials. Small paper mills use on an average 55 per cent agricultural residues, 40 per cent waste paper, and 5 per cent purchased pulp and other long fibre materials like cotton linters and rags.

Waste paper recycling is also increasing in India, even though it is still low (only 20 per cent) as compared to many European countries and Japan where it is as high as 50 per cent. Raw material and energy shortages, particularly electricity, have also become major constraints in existing paper mills based on bamboo. Capacity utilisation in the paper industry has steadily declined from a peak of 98.9 per cent in 1970 to 68 per cent in 1981. According to the Indian Paper Makers Association (IPMA), capacity utilisation in 1983 was only 58.1 per cent. Thus, even with this large capacity, the paper and paperboard industry could achieve a production of only 1.11 million tonnes in 1983, valued at Rs 1,200 crore . To achieve this production the mills used about 3.09 million tonnes of forest raw materials.

Large paper and paperboard mills are fully integrated to pulp production which is now based mostly on bamboo and hardwoods. These mills are generally located close to forests. The general policy is to be self reliant in fibre supply and use market pulp only as a "buffer" material. Bamboo, essentially a medium fibre material, was then available in the country in abundance. But now with bamboo resources shrinking large mills have no other option but to mix hardwoods with bamboo, even though there is a decline in pulp quality. Use of softwoods is still very limited. The 28 large integrated mills, with an installed capacity of 1.4 million tonnes, use on an average 60 to 65 per cent bamboo, 30 to 35 per cent hardwoods, and very minimally other fibrous materials. The paper industry claims that it today accounts for about 2 per cent of the country's annual consumption of wood and 51 per cent of bamboo.

**The paper and paperboards industry (1983)**

| | |
|---|---|
| Number of paper mills | : 175 |
| Annual capacity (million tonnes) | : 1.91 |
| Production (million tonnes) | : 1.11* |
| Capacity utilisation | : 58.1% |
| Forest raw material requirement (million tonnes) | : 3.09 |
| Per capita consumption (kg ) (USA; 272) | : 1.65 |
| Estimated value of actual production (crore) | : 1,200 |

* forecast
Source: Indian Paper Makers Association.

**Expected shortfalls in forest based raw materials for paper industry**

| Year | Paper and board production (million tonnes) | Forest raw material required (million air dry tonnes) | Newsprint production (million tonnes) | Forest raw material (million air dry tonnes) | Expected short fall ** (million air dry tonnes) |
|---|---|---|---|---|---|
| 1981 | 1.02 | 2.85 | 0.26 | 0.52 | — |
| 1991 | 1.57 | 4.40* | 0.43 | 0.87 | 2.06 |
| 2000 | 2.38 | 6.70* | 0.72 | 1.45 | 4.94 |

* Assuming 30 per cent production will come from use of un-conventional raw materials like agricultural residues.

** Assuming production of bamboo and pulpwood remains stagnant at current levles

Source: Development Council for Paper, Pulp and Allied Industries

### Bamboo crisis

The growing bamboo shortage poses production and ecological problems: overexploitation of existing forests and increased exploitation of remote forests. M.K. Raina, chairperson of IPMA claims that even at the present low levels of production "we are faced with the spectacle of a virtual scramble among paper mills for the limited quantities of forest produce available". "The crucial problem is the drying up of raw material resources," insists Raina. "To make matters worse, state governments have been revising royalty rates frequently."

According to the Pre-Investment Survey of Forest Resources, annual production of bamboo varies from 2.5 million tonnes to 3.0 million tonnes. About 1.6 million tonnes is supplied to existing paper and pulp mills and the remaining is used for construction by poor rural and urban people. Bamboo is popularly known as the poor person's timber and is already in short supply because of the paper mills. No sizeable bamboo resources remain to sustain new paper and pulp mills or even to feed the expansion of the existing ones S.G. Rangan, a senior manager of Seshasayee Paper Boards Ltd, laments: "Large paper mills have invested huge sums of money on the basis of long term lease agreements with state governments in respect to bamboo and it is imperative that the state governments honour whatever commitments they have made to the mills in letter and spirit. Thus, it becomes necessary that these committed areas should not be given to other mills unless and until the requirements of the existing mills are first met." Rangan further argues: "Only Assam seems to have some bamboos still left, though exploitation of this commodity has commenced as many as five years ago. Some big paper mills in our country have started getting bamboos from Assam in spite of the fact that the mills are located far away from this northeastern state. Without scientific planning of artificial plantations and depending only on natural growth, the bamboo clumps in Assam are likely to die a natural death within a few years due to overexploitation and non-compliance of silvicultural practices."

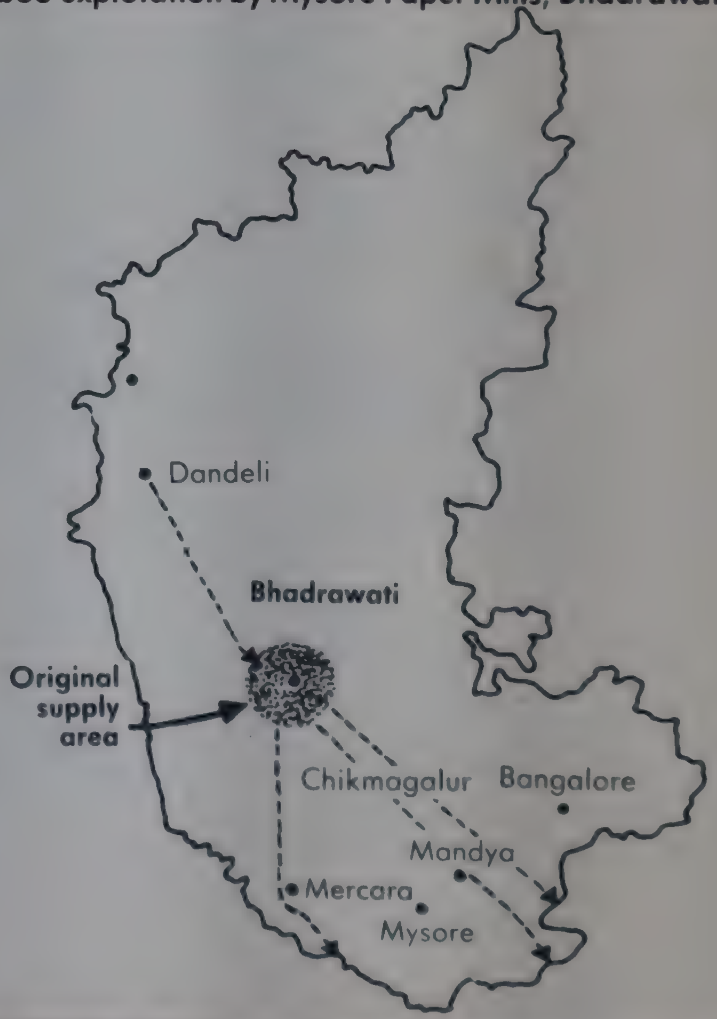
In a similar vein, S. Biswas, chairperson and managing director of Titaghur Paper Mills points out: "Over the years we have seen our average haulage increasing gradually but as the forests got degraded, the sources shifted to more remote areas in the Northeast. Even our source in Orissa is threatened. The Orissa government's industrialisation plans mean that more mills would come up in Orissa and it would be increasingly difficult for us to get raw materials from Orissa. Today less than 10 per cent of our needs are satisfied from West Bengal, of which much is procured from homestead growth of bamboo and pulpwood."

An official of the IPMA points out that yields per hectare of bamboo have been steadily declining due to lack of proper management in bamboo areas leased out to paper mills. "In most of the leases let out to different paper mills," the official points out, "the state governments insisted on a minimum royalty based on an approximate minimum yield expected from the leased areas. But the minimum yield for which royalty is realised is not available in most cases. Consequently, the paper mills pay more royalty per tonne than what is indicated in the lease. The reason for this situation is that the expected yield is based on visual expectation or on a resource survey not carried out scientifically."

In a study of three Karnataka paper mills, Dr Madhav Gadgil and S. Narendra Prasad of the Indian Institute of Science say that these mills consistently overestimated

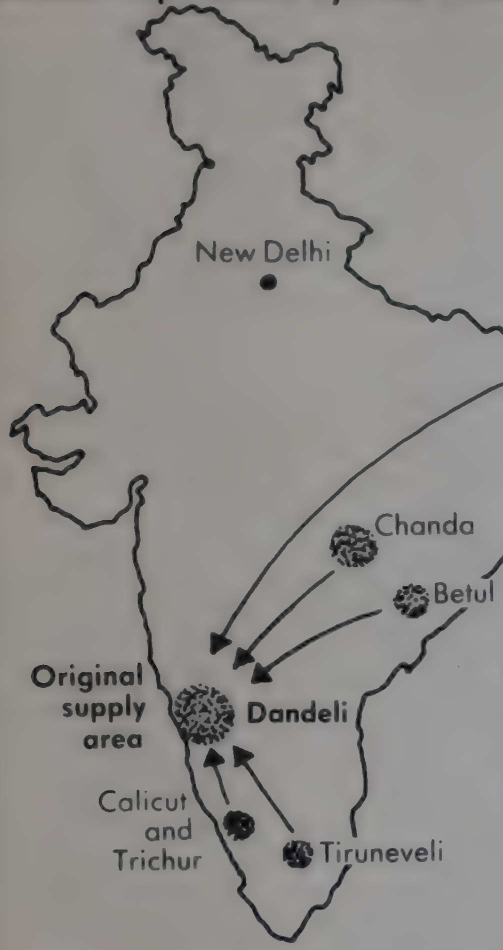
Smitu Kothari

**Bamboo explotation by Mysore Paper Mills, Bhadrawati**



Having depleted the forests allocated in the 1930s, Mysore Paper Mills is now exploiting distant forests.

**Bamboo exploitation by West Coast Paper Mills, Dandeli**



**With actual yields from its forests a fourth of those estimated, West Coast Paper Mills now gets bamboo even from Meghalaya.**

sustainable yields from bamboo stocks in the state—presumably to get the sanction for their mills or to increase their capacities. The paper mills are violating silvicultural regulations in their attempt to meet their needs and these have completely destroyed bamboo forests. When the Mysore Paper Mills was established at Bhadrawati in 1937 it was calculated that the bamboo yield annually obtainable on a sustained basis from the Bhadrawati forest division was over 100,000 tonnes but the yield estimates did not take into account the cyclic flowering of bamboos (after each flowering, the bamboo drops its seeds and dies out, new plants come up from the seeds). The company slowly started exploiting bamboo resources of other forest divisions outside its original supply area. The concessional area in Uttar Kanara allotted to the West Coast Paper Mills was estimated as yielding 150,000 tonnes a year. Again no account was taken of the possibility of gregarious flowering. The annual yield has averaged only about 40,000 tonnes forcing the company to bring in bamboo from Kerala, Tamil Nadu, Maharashtra, Andhra Pradesh and from as far away as Meghalaya.

The Mandya National Paper Mill uses bagasse and not bamboo as the major raw material. The mill was nationalised in 1965. At that time it was promised an annual supply of 140,000 tonnes of bamboo, from three forest divisions already being exploited since 1945–55 by Mysore Paper Mills, itself struggling to meet its annual requirements of 55,000 tonnes. Mandya National Paper Mill has not been able to receive even 25,000 tonnes of bamboo per year.

The Seshasayee Paper Mills in Tamil Nadu started in 1962 and at that time 90 per cent of its raw material came from bamboo; the rest was bagasse. The state forest department has rarely supplied enough bamboo to the mill whose capacity has expanded from 60 tonnes per day to about 160 tonnes to 165 tonnes per day at present. Now bamboo supplies meet only 30 per cent of its raw material needs; the rest comes from eucalyptus (20 per cent), acacia (20 per cent), wattle (10 per cent), cashew and rubber (7 per cent), and miscellaneous species (3 per cent). The surrounding forests have been heavily exploited and local basket weavers are facing an acute crisis because of the soaring prices of bamboo. This mill may also have to import bamboo soon from distant areas like Assam and Madhya Pradesh.

Similarly, the Orient Paper Mills at Amlai in Madhya Pradesh has almost completely exhausted bamboo stocks in the Shahdol district where it is situated and today draws its bamboo from all over eastern Madhya Pradesh—from Balaghat, Hoshangabad and Betul, and various places some 500 km away. Most paper mills are now paying Rs 300 to Rs 400 per tonne to get forest raw materials at the site; in some cases, companies are paying as much as Rs 534 per tonne.

### Forests in danger

In such a raw material crisis, all companies, private and public sector, want to head towards the last forest frontiers like Bastar, the Northeast and the Andamans. The government expects that the three paper mills of the public sector Hindustan Paper Corporation at Tuli in Nagaland and at Nowgong and Cachar in Assam will soon increase the country's paper production capacity by 233,000 tonnes of paper and paperboard. These plants will use bamboo as their main raw material. Lack of transport infrastructure is the main stumbling block in the exploitation of the 'green mines' of the Northeast but, once better roads are built this area is certain to be devastated. Meanwhile, a public sector paper mill is being considered by the Andhra Pradesh Industrial Development Corporation for Kakinada. This paper mill will use wood chips from the virgin Andaman Islands as its main raw material.

State governments in their bid to attract industry and politicians in their bid to make big money have often given away bamboo forests on lease at throwaway prices. The Orient Paper Mills at Amlai was initially given bamboo at dirt cheap prices, 37 paise per tonne by the Madhya Pradesh government. The Seshasayee Paper Mills in Tamil Nadu was paying Rs 6.89 per tonne until 1970, Rs 11 from 1970 to 1975, and Rs 22 plus 5 per cent for administrative expenses since 1975. Paper mills in Karnataka were paying Rs 15 per tonne for bamboo when the poor could purchase it in the open market only at Rs 1,200 per tonne.

In recent years, however, many state governments have begun to revise royalty rates steeply upwards. Inevitably, all kinds of dirty tricks are played to get access to cheap raw materials. When the Orient Paper Mills closed down its Brajrajnagar plant in Orissa ostensibly because of the workers' agitation for more bonus it was widely rumoured that the management had done so deliberately to bring in cheaper bamboo from Orissa and pressurise the Madhya Pradesh government which had suddenly jacked up bamboo rates to Rs 102 per tonne in 1981. There is also the case of a West Bengal paper mill which had approached the Bihar government for allocating forest areas for its raw material requirement after its own sources in West Bengal ran short. But when the Bihar government refused to do so unless the mill was set up in Bihar, all that the company had to do was to send its trucks to the Bihar-West Bengal border.

Thousands of headloaders would illegally deliver wood to it every day.

In 1980, the Public Accounts Committee of the Karnataka legislature had studied the sale of eucalyptus plantations to the Gwalior Rayon Silk Mills—the rayon industry is another major user of pulp—at Rs 24 a tonne which was lower than the cost of production of Rs 44 a tonne. The committee suggested that the price was very low and in February 1981 the price of eucalyptus was fixed at Rs 81 a tonne. But five days later the then chief minister R. Gundu Rao gave oral instructions that the forest department should continue to sell forest produce at the old rates to industries after securing a bank guarantee representing the difference between the old and new rates. In April 1981 fresh instructions were issued to continue supplies at old rates against a bank guarantee of only Rs 5 lakh . The committee indicted the chief minister for staying the operation of the new rates, declaring it illegal and saying that it had led to a loss of Rs 22 crore . The committee also expressed dismay over the disappearance of the file in which Gundu Rao's oral instructions staying the revised rates were recorded.

But many state governments have not learnt the lesson of charging low royalties in the first place. The new 80,000 tonne per year newsprint plant of the public sector Hindustan Paper Corporation will pay the state of Kerala only Rs 11 per tonne of green wood of eucalyptus far below the cost of plantation. The Kerala government will supply eucalyptus and reeds on a sustained basis in adequate quantities. The management, however, does not rule out acute raw material shortages unless a massive plantation programme is taken up. Part of the mill's requirements are already being met through imported pulp.

Smitu Kothari

## While the Nation Scrounges for Wood . . .

The acute shortage of wood threatens even such abiding symbols of Indian culture as bullock carts, catamarans and mud roofs. This situation is all the more alarming because they have survived centuries of technical change.

Take the case of kattumarams — catamarans in English — of which there are an estimated 26,000 to 30,000 in Tamil Nadu alone. Each boat has to be replaced after five to seven years and in this way some 5,000 boats are replaced every year in the state, which means that some 17,500 cubic metres of wood is consumed for this purpose.

One type of wood which is used to make these boats is bombax', which has become popular because it is cheaper than others such as 'aini'. A study by Dr. C.V. Seshadri of the Murugappa Chettiar Research Centre in Madras estimates that wood from some 75 hectares to 100 hectares of bombax plantations would be needed for the new crop of boats every year. As the tree grows slowly and is usually cut after 30 years, some 30 of such plantations are necessary. Each boat brings in about 2 tonnes of fish a year — sold at Rs. 5 a kg — and each hectare of bombax would yield, by this calculation, Rs. 6 lakh a year. No crop matches such high yields or employment. But as Seshadri asks: "Is there ever going to be afforestation for people who are not in any organised sector?". The centre is now designing a catamaran made of high density polyethylene pipes.

From Ungra village in Karnataka comes another disturbing piece of news: in the last eight years, no new bullock cart based on traditional designs has been purchased here, only new carts of modern design and shod with discarded truck tyres are favoured. The change came in 1974 when, as a study by the Indian Institute of Science, Bangalore, makes clear, the prices of traditional bullock carts began to rise. The reason was that transporting teak, used for the spokes and rims of the wheels became costlier and costlier. By 1982, the wheels contributed to 73 per cent of the cart's total cost and teak alone accounted for 53 per cent of the cost. In fact, timber prices rose 2.5 times faster than tyre prices during the 1970s, pricing traditional bullock carts out of the market — although a thriving trade in second-hand carts opened up.

Yet another distress story, comes from Nirmal, 200 km from Hyderabad in Andhra Pradesh, known for its hand-crafted wooden toys, which are exported in substantial quantities. The art is believed to go back a thousand years and is based on a light wood called 'ponki', purchased from local or nearby forest sales depots. Local fisherfolk use ponki for their catamarans and the toy makers even borrow from them when supplies run short. Ponki is today in real short supply. And where in 1967 one unit cost 25 paise it now costs Rs17.50. In a desperate bid to survive the toy makers' cooperative is trying to get 40 hectares earmarked for plantation.

The wood shortage has also hit mud-roofed houses. In the hill regions of northwestern India, for instance, 'dhajji diwar' constructions are rapidly disappearing. These consist of a wood frame structure set on a stone base. Clumps of wet earth are piled and packed closely into the wooden frame and the entire structure plastered with mud and lime. Timber roof trusses span the walls and an irregular patchwork of overlapping slates covers the roof. Dhajji diwar houses are earthquake resistant and can be put together by the owners from materials collected on or around the site.

The Central Building Research Institute (CBRI) surveyed dhajji diwar houses in the Chakrata region of Dehra Dun District, where a typical house has two rooms on two floors, the lower one used by cattle and for grain storage and the upper for living. Currently, the estimated two full-grown deodar trees required

FOREST
GOVERNMENT

for the average 200 sq ft house are difficult to get. Additionally the families who are entitled to deodar at concessional rates have to cart the wood over long distances to their homes, which increases the cost. The Uttar Pradesh government is generously but short-sightedly granting Rs 3,000 to anyone wishing to build a pucca brick and concrete house, though few people have taken advantage of this offer.

There are no published reports about the shortage of wood for agricultural implements. But in the Garwal hills the shortage of ash wood used traditionally in bullock ploughs came to light because forest officers insisted on supplying pine wood to villagers. While the villagers were denied ash wood sports goods manufacturers continued to get ash. This was one of the factors which led to the now-famous Chipko movement.

Even modern consumers have not been spared by the wood crisis. The 51 large plywood factories in India functioned at just over half their installed capacity in 1981 and capacity utilisation is said to be falling further. In the same year, the 100-odd small plywood units could manage only 16 million sqm of production against an installed capacity of 25 million sqm.

Another industry tearing its hair out is the match industry. Current per capita consumption of matches per day is 3.86 but is expected to rise to 6.8 sticks by the year 2000. Even if the entire industry switched over to cardboard boxes, the wood shortfall would be 45 per cent and if all matches were made of wood, the shortfall would be 65 per cent. An angry industrialist said that the government collects Rs 55 crore every year in excise duties but does little in terms of afforestation.

Multinational match manufacturer, Wimco has started Wimco Seedlings Ltd in collaboration with two Swedish companies to undertake research and development in genetics and commercial seed production. Wimco had launched a forestry extension scheme in 1975, encouraging farmers to plant hybrid poplar seedlings supplied by it. But, as the Wimco managing director says, "there is a severe lack of research that is relevant to market requirements". Wimco Seedlings plans to work on a range of fast-growing trees, and the seeds and seedlings it develops will be marketed by Wimco.

The agarbatti industry in Karnataka is also passing through hard times. Manufacturers in the state need 2,000 tonnes of bamboo splinters every year and, with Karnataka's bamboo forests destroyed, they are being forced to get them from Assam and Orissa. If the current scarcity situation continues, over 2 lakh agarbatti workers will be forced out of work in the near future — a future that is coming nearer and nearer.

## . . . Tensions Grow Between the Forest Bureaucracy and the Poor

Battlelines for control of forests and their produce are being drawn more and more sharply. In Bhandara and Chandrapur districts of Maharashtra, 70,000 men and women make a living out of manufacturing mats and baskets of bamboo, exported all over Maharashtra. 'Burad' is what the workers are called, most of them adivasis and scheduled castes, almost half of them landless. But their traditional occupation is in danger because the government has stopped supplying them with bamboo.

The burad workers used to freely enter forests and cut the bamboos. Then the British introduced a pass and a fee of Rs 10 for the privilege. In the mid 1960s the government started a rationing system with cards called burad vahi; where each cardholder was permitted to purchase 150 bamboos per month from the forest department depots for Rs 90—today the price is Rs 175. With the card came corrupt forest officials.

Simultaneously, large bamboo tracts were leased out to paper mills and contractors who started indiscriminate cutting. The forest officials allowed bamboos to be cut even from areas not leased out. The burad workers very often found officials claiming that there was not enough bamboo available to give them the full quota. While the contractors amassed fortunes the burad workers have had to trek miles to the nearest depot to lift their quota, which was often dry old bamboos which made their work twice as laborious, and for which they paid more than a rupee a piece.

The government also restricted the villagers' right to cut bamboos to repair their huts, allowing them only 75 bamboos annually. Anyone caught cutting bamboos was arrested and fined at Rs 5 per bamboo cut "illegally". Restrictions on villagers for cutting fuelwood also exist.

Three years ago, things suddenly took a turn for the worse: the government stopped supplying bamboo to the workers from the depots, and withdrew permission to cut 75 bamboos per year for hut repairs.

Some burad workers in the villages around Kohmara depot of Bhandara district, launched a struggle. Kohmara lies on the main highway to Calcutta near the Madhya Pradesh border. On December 13, 1981, they held a big meeting in front of the depot to press their demand for the resumption of the bamboo supply. Meetings and organised morchas continued until March. Promises to look into their problems from the forest minister and another minister came to nothing. The workers formed the Bhartiya Burad Kamgar Mahasabha with its headquarters at Sadak Arjuni.

On March 15, 1982 they started a relay hunger fast after a massive morcha to the Collectorate. On April 16 they began a 'bamboo roko' campaign. As the first step they stopped a contractor's truck full of bamboos, asking the police and forest officers to check the amount of bamboo in the truck. The police lathi-charged them to free the truck.

On April 18 over 500 men, women and children squatted on the Calcutta highway at 8 a m and blocked all traffic. Trucks and cars piled up for miles on both sides. In the evening, after a deal with the police the 'rasta roko' was lifted. As soon as the people started going back to their homes, the police went on a rampage, lathi-charging the people, entering houses at Sadak Arjuni and Saongi villages, beating up women and children. Sixty-four people, including women, were arrested.

The government finally began giving 25 bamboos to burad workers at the Kohmara depot. At the other depots the supply was not resumed for a long time. But the burad workers had clearly shown how the government has turned the forest wealth over to the rich.

**Modern industry in its hunt for bamboo is pushing out thousands of tribal artisans like basket weavers. (Smitu Kothari)**

### Contrasting scenarios

Two sets of ideas for future management of forests have emerged. The first, mainly supported by environmentalists, is that none of the remaining natural forests should be exploited for industrial raw material requirement. In a document entitled 'Recommendations of the Department of Environment regarding the revision of the National Forest Policy', the department clearly states: "It is not feasible any longer to exploit the remaining natural forests to start new or to expand existing forest-based industries. No forest-based industries, whether in the big or small sector, should be permitted in the future unless they have been cleared after a rigorous scrutiny first by a central agency with special reference to their environmental consequences. Such projects may be permitted only if they are based wholly on new forest plantations, based on degraded and marginal agricultural lands . . . In certain cases, import of raw material for forest-based industry, especially paper and plywood may be encouraged in order to relieve pressure on our own resources." Indeed, in the last few years, the government has liberalised the import of pulp and waived import duty on waste paper and pulp. In order to protect the few remaining natural forests, the department strongly recommends: "No plantations should be raised by clearfelling natural stands of forests."

On the other hand the forest department's favourite option is to clearfell existing forests and replace them with plantations of fast growing species. The National Commission on Agriculture had recommended this approach. But many environmentalists assert that these plantations have been failures. Dr C.T.S. Nair of the Kerala Forest Research Institute points out: "Although anticipated yield from fully stocked eucalyptus plantations is about 80 tonnes to 100 tonnes per hectare at a rotation of 10 years, the average obtained hitherto has been less than 40 tonnes and in some plantations the yield has been as low as 10 tonnes per hectare."

Data collected by Dr Gadgil and his associates over six years in six ranges of Haliyal Division of Karnataka, a region with good rainfall, showed yields less than 10 per cent of the projected yield. The yields in Bangalore, a dry area, were 20 per cent of the projected yield. In fact, according to Gadgil, "this is a good record for eucalyptus plantations." Eucalyptus plantations were also taken up on a large scale by clearfelling excellent rainforests in many high rainfall tracts of the Western Ghats. The eucalyptus were attacked everywhere by a fungal disease wiping out extensive plantations, whose productivity was zero. This merely served to convert tracts of excellent rainforest into human-made deserts. Perhaps the best example of this is in the Parambikulam tracts of Kerala. The eucalyptus plantations of south Bastar were also largely total failures, with a survival rate of around one per cent.

Other species were planted in the Himalayas with one or more of the following : ash, deodar, cypress, chir pine, kail, walnut and horse chestnut. In the Badrinath division, the percentage survival of the plantations is an average of 14.2 per cent. In Garhwal, survival averaged 21.5 per cent and in Kedarnath division around 20 per cent. Gadgil produces data to show that even many plantations which have not failed, have not greatly improved in productivity over that of natural forests.

Whatever the reasons for these failures, these plantation programmes have had serious environmental and social implications. When a plantation is taken up, it destroys at a stroke resources like fuel and fodder on which the local population depend and thereby often raises strong feelings of resentment. Even as far back as 1941, S.S. Dhareshwar had documented the protests of the rural population of Uttar Kanara when teak plantations were first taken up in this area, and these protests continue to this date, but now against eucalyptus plantations. In Jharkhand, tribals have been burning down the teak plantations set up to replace old sal forests.

Gadgil is particularly critical of teak plantations. It is often argued that since teak fetches exceedingly high prices, a teak plantation improves the economic, if not biological, productivity of the land. But Gadgil argues that "teak does not fulfil any irreplaceable function. Its price is already sufficiently high so that metal, hardboard or chipboard provide equally desirable functional alternatives. The value of teak is therefore primarily as a luxury timber which now only the rich can afford."

### Game, Set and Match

The poplar is an excellent tree. Its wood is soft, white and of uniform density and is perfect for simple furniture, sports goods, pencils, packing cases and so on. It is also good for matches.

This is where match giant Wimco comes in. For the last seven or eight years, anticipating a shortage in the coming decades, Wimco has been supplying poplar seedlings to farmers in the prosperous terai region of Uttar Pradesh and elsewhere; in 1982, it distributed 2 lakh of these at a nominal charge of 50 paise a seedling. It also provided extension services. The motive was not, of course, entirely unselfish: fearful that wood reserves were running out, the company decided to create its own, and the seedlings provided by it today sprout in most of the northern states.

In 1984 it got ambitious. The National Bank for Agriculture and Rural Development (NABARD) approved a Rs 90 crore poplar cultivation scheme for Uttar Pradesh, Punjab and Haryana, put forward by Wimco. The main features: farmers will get a loan worth Rs 123 per each entire transplant (ETP) in UP, Rs 157 in Punjab and Rs 137 in Haryana; each ETP would be sold to farmers by Wimco for Rs 12.50; extension service fee per seedling would be charged by Wimco, varying from Rs 36 in Uttar Pradesh to Rs 37 in Punjab to Rs 40 in Haryana; other costs of planting would vary from Rs 108.33 per ETP in Uttar Pradesh to Rs 138 in Punjab to Rs 120.05 in Haryana; 85 per cent of the total cost of planting would be loaned by banks, which would be refinanced by NABARD; Wimco would be reimbursed Rs 48.50 per ETP in Uttar Pradesh, Rs 49.50 in Punjab and Rs 52.50 in Haryana; with the survival rate estimated at 90 per cent, the average cost of plantation works out to Rs 72,500 for 500 trees.

The Uttar Pradesh forest department is furious. It charges that the seedlings are too expensive at Rs 12.50 each—it gives each for a rupee—as are the extension service fees. Thus Wimco will not only have a monopoly on purchases of poplar but will also make money on extension services. Executives, on the other hand, say that the ETP cost is reasonable and that the extension service that Wimco would provide would be worth the cost. The forest department is not prepared to accept this. Says a district forest official: "the department has the best expertise and experience in this field. How can Wimco claim to be better?"

Wimco has claimed to be better and has got away with it. Perhaps NABARD does not trust the state foresters enough. Whatever the reason, the multinational manufacturer has already supplied about 1.5 lakh seedlings in 1984 and intends to supply 2 lakh in the next year. It has thus theoretically amassed Rs 72.75 lakh in seedling and extension service charges alone. And the forest department has been left watching from the sidelines. So have many farmers. One complains: "we can now go in for poplar planting only through Wimco, because they are the main agency arranging for loans from banks." The scheme also puts farmers in enormous debt.

**Big money and industry can combine to make expensive trees. a nursery supported by the National Bank for Agriculture and Rural Development. (Business India)**

### Ongoing problem

Apart from the protection of the remaining natural forests, the raw material problem of the paper industry is serious and cannot be wished away. The Raw Material Committee of the Development Council of the Paper, Pulp and Allied Industries has calculated that to ensure a per capita consumption of 4.5 kg per person by 2000 would mean increasing the total manufacturing capacity to 4.25 million tonnes of paper and board and 1.289 million tonnes of newsprint. With 80 per cent capacity utilisation, this would produce 3.4 million tonnes of paper and board and 1.031 million tonnes of newsprint. Thus, the forest raw materials demand is expected to go up from about 3 million tonnes to 5 million tonnes at the moment to about 14 million tonnes (about 3.5 million tonnes of bamboo and 10.5 million tonnes of pulpwood), even after assuming that 30 per cent of the capacity of paper and board will be fed by agricultural residues.

The committee has made a series of recommendations. Firstly, the mills should make technological changes to progressively reduce the consumption of bamboo from 60 per cent to 70 per cent of the raw material to 30 per cent by increasing the component of wood to 70 per cent. Japan, for example, has been able to turn out high quality paper from 90 per cent to 100 per cent hardwoods. The bamboo shortage is expected to be even more critical than the wood shortage. As bamboo plantations are considered to be economically feasible only in high rainfall areas with suitable soils the bamboo needed will have to come mainly from natural forests. By practising intensive rejuvenation, the productivity of bamboo forests can be increased by 30 per cent in leased bamboo areas. All paper mills hold long term leases of bamboo forests. This will mean that current availability of bamboo of 1.7 million air dry tonnes can be increased to 2.2 million tonnes, which would just about meet the requirements of bamboo by 2000, if at the same time the proportion of bamboo in the raw material furnished can be brought down to 30 per cent.

**Capacity utilisation in paper and paperboard industry in India (excluding newsprint)**

| Year | Capacity Utilisation (percentage) |
|---|---|
| 1960 | 86.3 |
| 1970 | 98.9 |
| 1975 | 76.1 |
| 1981 | 68.0 |

Source: Development Council for Paper, Pulp and Allied Industries.

To meet the additional 8 million tonnes of pulpwood needed annually, some 1.6 million hectares of pulpwood plantation will be needed to be raised over the next 10 years so that required pulpwood is available by 2000 AD. This is based on the assumption that eucalyptus plantations will yield 40 tonnes of wood per hectare in an eight-year rotation. Thus, 1.6 lakh hectares need to be planted every year, with immediate effect. In raising one hectare of plantation, Rs 5,500 will be needed from the first to the eighth year, at present costs in the case of unirrigated plantations. The total investment in the eight year period for planting 1.6 million hectares will be Rs. 900 crore. These figures may be underestimates because they assume that current forests will continue to yield what they are yielding at the moment, which certainly does not seem to be the case.

The committee has made a package of proposals. Firstly, it says that industries should be given large tracts of degraded forest land to plant their trees and meet their own raw material requirements. The committee recommends relaxation of the land ceiling act to implement such a step. The companies also want concessional finance so that plantation costs do not become high and make paper too expensive. The committee warns that if the government does not move quickly, India will be importing 2 million tonnes of paper and board every year, which will mean an annual drain of Rs 1,600 crore (at 1982 prices).

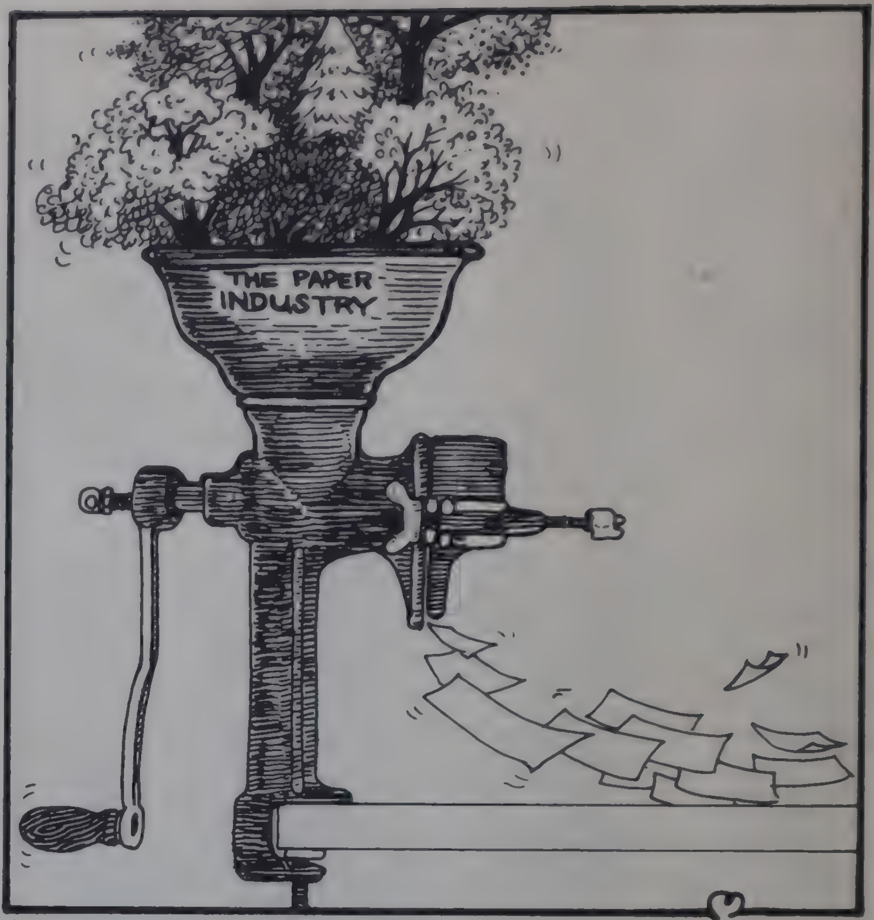
The third suggestion is to encourage "social forestry around the mill". Paper mills can distribute free seedlings of suitable pulpwood species to farmers who can grow them on their farm bunds and fallow lands allowing the mill the first option on the produce. The paper mills can involve the leading bank in the district through the National Bank of Agriculture and Rural Development (NABARD) so that the farmers get a loan for plantation as also a consumption loan to take care of their needs until the trees mature. The mill will buy the wood at maturity and pay the bank the arrears of the farmers with interest, deduct its own investment in providing seedlings and fertiliser, and return the farmers the residual money. Such a scheme has been approved by NABARD for Sree Rayalaseema Paper Mills in Kurnool in Andhra Pradesh.

The committee dismisses the argument that this could lead to disastrous monocultures. "The ideal situation would have been that two to three species could be perfected to yield the same quantity in the same climatic zone so that mixed plantation would have been feasible. In the absence of such a case, monoculture will have to be done. However, the plantation of 1.3 million hectares in islands of monoculture, spread over the length and breadth of the country is not very significant, being 0.43 per cent of the total land area of the country." These arguments of the paper industry are being supported by politicians and Union ministers. Narayan Dutt Tiwari, Union Minister for Industry told the DCPPAI in 1982 that paper mills should now begin to plan their own raw material supply.

**Private enterprise**

The biggest argument in favour of handing over land to private farmers for afforestation is that they will be far more efficient than public agencies. Gadgil's survey of Karnataka districts showed that the government spends Rs 2,000 per hectare, not counting infrastructure overheads, to achieve yields of under 2 tonnes per hectare per year while the farmer spends a mere Rs 500 to Rs 1,000 per hectare to achieve yields of over 10 tonnes per hectare per year. A similar picture emerges from a study of private farmers in Tamil Nadu.

The first step to hand over forest land to private industry was taken by Karnataka. In March 1982, it announced a policy decision to entrust forest lands to industries within the state for raising plantations of pulpwood at their own cost and to give the government a part of the produce in lieu of either land rent and/or royalty. If the government decides to sell its share of the produce, the grower industry would have the right of first refusal for purchasing such material at rates prevailing at that time. The company to benefit is Mysore Paper Mills, which has been leased about 30,000 hectares, on which it plans to grow eucalyptus. The company is also beginning to adopt silvicultural based operations in its bamboo concessional areas but it still believes it will have to import pulp for its recently setup newsprint plant.



The wood-based industry is a hungry consumer. Paper mills alone account for over half of all bamboo used annually. (WWF-India)

## Forest Loss

Satellite data has finally confirmed what environmentalists have always feared. India is losing forests at an extremely rapid rate which makes a mockery of the figures presented by the forest departments. The data released in mid-1984 by the National Remote Sensing Agency (NRSA) shows that India lost 1.3 million hectares of forests every year in the approximately seven year period between 1972-75 to 1980-82, which is even higher than the guesstimate of one million hectares annual loss presented in the citizens' report on the State of India's Environment in 1982. But it is as much as eight times more than annual deforestation rate of 0.15 million hectares claimed by the forest departments.

Though the government claims that 23 per cent of the country's land area is under the control of the forest departments, satellite pictures revealed that during 1972-75, only 16.89 per cent of the land area actually had forests. This figure may have been slightly higher as some areas could not be analysed because of cloud cover. By 1980-82, the forest cover had gone down to 14.10 per cent of the country's land area which is well below FAO's estimate of 17.4 per cent for the same period. In other words, as much as a sixth (16.25 per cent) of the country's forest cover in 1972-75 was lost in the subsequent seven years.

The NRSA study breaks down the forest cover into three categories: closed forests, open or degraded forests and mangrove forests. Closed forests dropped from 14.12 per cent to 10.96 per cent, degraded forests increased from 2.67 per cent to 3.06 per cent and mangrove forests dropped from 0.099 per cent to 0.081 per cent. Thus, during the two periods India lost 10.4 million hectares of closed forests and 63,000 hectares of mangroves, and 1.29 million hectares of closed forests got converted into degraded forests.

Actually the extent of degraded forests would be much higher and that of closed forests would be much lower if the international classification of forests had been followed by the NRSA study. This study considers a closed forest forest whose canopy covers 30 per cent of the ground cover as compared to 40 per cent in international studies.

The study points out that Arunachal Pradesh, Manipur and Andamans and Nicobar Islands are the only areas which fulfil the stipulation of 60 per cent forest cover in hill regions laid down by the National Forest Policy in 1952. The maximum deforestation has occurred in Madhya Pradesh, which lost nearly two million hectare, Maharastra over a million hectare, Orissa, Andhra Pradesh and Jammu and Kashmir nearly a million hectare, and Himachal Pradesh and Rajasthan over half a million hectare. But in terms of the proportion of forest area lost in the seven year period, states and union territories which already had a low forest cover suffered the most: Punjab lost over half the forest cover that existed in 1972-75, and Rajasthan, Haryana and Gujarat nearly half. States like Himachal Pradesh and Jammu and Kashmir lost over a third of their forest cover, Maharastra a quarter and West Bengal and Tamil Nadu over a fifth.

Except for Tripura, Manipur, Meghalaya and Mizoram, all the states and union territories show less forest area than reported by the Ministry of Agriculture. Quite significantly, says the NRSA report, shifting cultivation is extensively practised in these states. The secondary forests which have sprung up in abandoned shifting cultivation areas were apparently not being included by the Ministry in its forest cover statistics, which is probably the result of another myth that shifting cultivators have a disastrous impact on forests.

The NRSA study was completed within a year of being commissioned. Clearly this kind of monitoring is needed on a regular basis.

### State-wise forest areas by satellite date

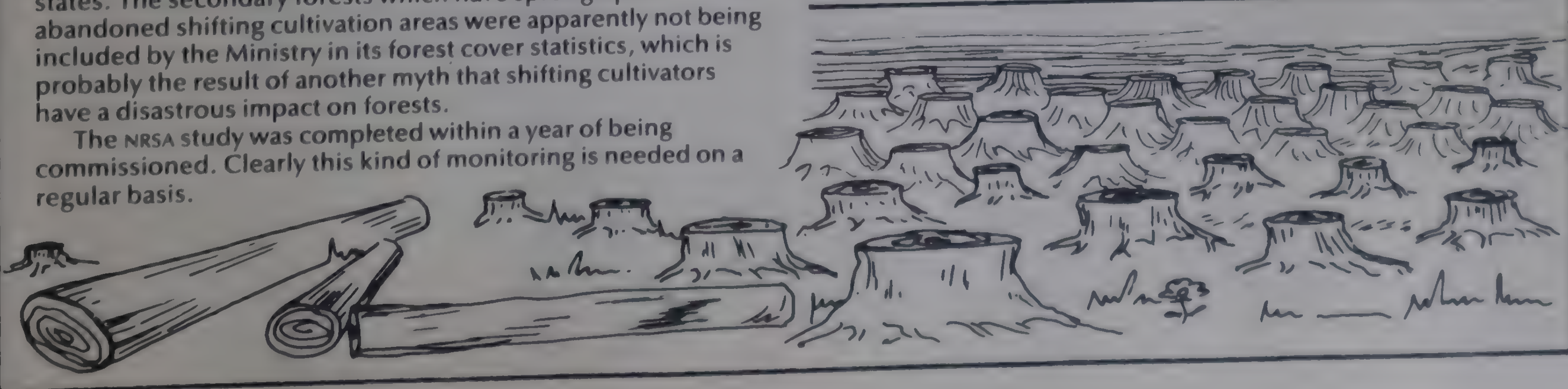
| State/Union Territory | Forest area by satellite data 1972-1975 | 1980-82 | Area controlled by forest department 1980 |
|---|---|---|---|
| Andhra Pradesh | 4.90 | 4.04 | 6.41 |
| Assam | 2.11 | 1.98 | 3.07 |
| Bihar | 2.27 | 2.01 | 2.92 |
| Gujarat | 0.95 | 0.51 | 1.95 |
| Haryana | 0.08 | 0.04 | 0.16 |
| Himachal Pradesh | 1.51 | 0.91 | 2.21 |
| Jammu and Kashmir | 2.23 | 1.44 | 2.19 |
| Karnataka | 2.95 | 2.57 | 3.79 |
| Kerala | 0.86 | 0.74 | 1.11 |
| Madhya Pradesh | 10.86 | 9.02 | 15.39 |
| Maharashtra | 4.07 | 3.04 | 6.41 |
| Manipur | 1.51 | 1.38 | 1.52 |
| Meghalaya | 1.44 | 1.25 | 0.86 |
| Nagaland | 0.82 | 0.81 | 0.29 |
| Orissa | 4.84 | 3.94 | 6.77 |
| Punjab | 0.11 | 0.05 | 0.24 |
| Rajasthan | 1.13 | 0.60 | 3.49 |
| Sikkim | 0.18 | 0.29 | 0.26 |
| Tamil Nadu | 1.67 | 1.32 | 2.18 |
| Tripura | 0.63 | 0.51 | 0.59 |
| Uttar Pradesh | 2.59 | 2.10 | 5.14 |
| West Bengal | 0.83 | 0.65 | 1.18 |
| Andaman and Nicobar Islands | 0.33 | 0.64 | 0.71 |
| Arunachal Pradesh | 5.14 | 5.21 | 5.15 |
| Dadra and Nagar Haveli | 0.02 | 0.01 | 0.02 |
| Goa, Daman and Diu | 0.12 | 0.11 | 0.11 |
| Mizoram | 1.39 | 1.20 | 0.71 |

Source:- National Remote Sensing Agency

### Vital forest statistics

| | 1972-75 | 1980-82 |
|---|---|---|
| Forest cover (million hectare) | 55.52 | 46.35 |
| Closed forests (million hectare) | 46.42 | 36.02 |
| Open forests (million hectare) | 8.77 | 10.06 |
| Mangrove forests (million hectare) | 0.33 | 0.26 |
| Forest cover (% of total land area) | 16.89 | 14.10 |

Source: National Remote Sensing Agency



Several other governments have been considering similar schemes: Madhya Pradesh, Andhra Pradesh, Gujarat and Maharashtra. The Maharashtra forest minister announced at a seminar held at Uruli Kanchan in 1981 that industrialists willing to develop forests would be given government land for 50 per cent of the income from the trees. In late 1983, Chief Minister Arjun Singh of Madhya Pradesh announced that his government has also decided to give land to forest-based industries to grow their own wood. The state forest development corporation will be prepared to share the investment equally with the beneficiary firm. Registered village cooperatives and cottage industries will also be eligible for an allotment of 100 hectares of land. Only barren lands will be given to industries and if non-tree crops are planted, they will be confiscated by the government.

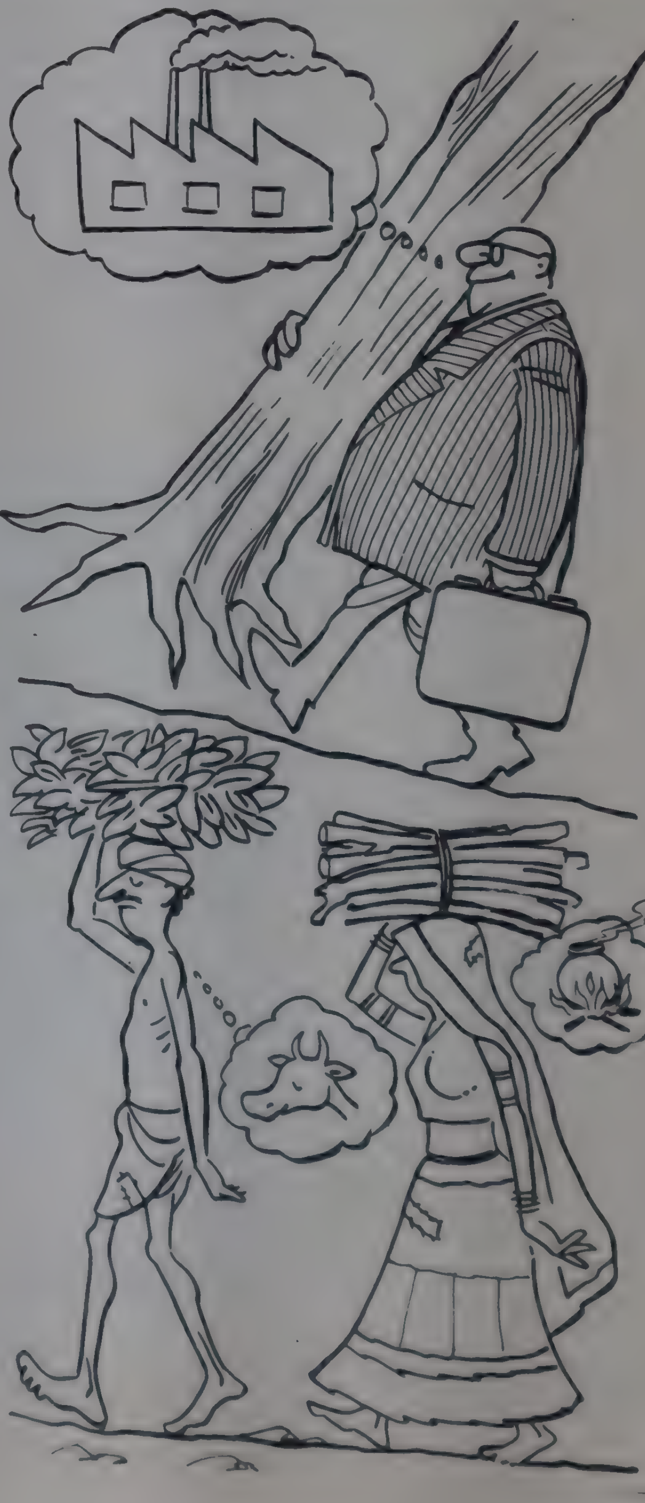
Elaborate schemes prepared in Andhra Pradesh and Gujarat have, however, run into political trouble. In Andhra Pradesh, the government is committed to supply raw materials to the local paper mills at Rs 60 per tonne. But when the government increased this to Rs 250 per tonne, the paper industry went to court pleading that this was an arbitrary decision. The government does not believe that the Andhra Pradesh Forest Development Corporation (APFDC) is capable of taking up an afforestation programme on the scale required. Industrialists too do not believe that the increased revenue to the state through enhanced royalty rates will result in afforestation. But the government finds that industrialists are prepared to take land and undertake their own afforestation.

The scheme prepared by the Andhra Pradesh government will, firstly, consider taking out a lease on the land, so that there is general revenue for the state. The land will be leased out to the APFDC, which will in turn hire a forest-raising contractor on a 20–year agreement. This hiring arrangement will help circumvent land ceiling laws. APFDC will buy back the produce at prices considered to be the forest-raising cost of the contractor. It will then add sales tax and mark-up for its own revenue and sell it back to the forest-raising contractor, who will have the first right of refusal. Through this complicated procedure the government hoped to circumvent the obstacles posed by the land ceiling acts and the Forest Conservation Act, which forces the state to seek the permission of the centre for diverting any forest land. The state government had drawn up plans to distribute about 40,000 hectares of forest land to the four paper and rayon manufacturing units in the state. A senior Andhra Pradesh government official explained: "If we do not provide the raw materials to the industry at the low rates agreed earlier or give them forest land, which they are happy to take, they will go to court or simply announce a lock-out. Then trade unions and politicians will be breathing down our necks."

About four years ago, the Gujarat government had also formulated a programme of giving unproductive barren land on a lease of 30 years to voluntary organisations and industries for afforestation. Some 132 firms applied which included Jyoti Limited of Nanubhai Amin, a major manufacturer of solar energy devices, Ion Exchange of Shankar Ranganathan, a leading environmentalist, and Tata Industries, Mithapur. The firm getting land was expected to plant at least 400 trees per hectare. Twenty per cent of the material produced was to be given to the government at prices fixed by the government. This produce would be made available to low income people to meet their timber and firewood needs. A total of 50,000 hectares was requested by the industrialists. But this scheme has been strongly opposed by tribal leader Jinabhai Darji and has been stalled because of his influence. Jinabhai feels that land should only be given to tribals or other underprivileged groups.

**Plantation concepts**

The communist government of West Bengal has taken a slightly different approach: putting 'social forestry' schemes at the service of pulpwood production. The Titaghur Paper Mills (TPM) and the West Bengal Pulp Wood Development Corporation (WBPWDC) are to plant commercial pulpwood and bamboo forests on marginal lands. The new corporation is headed by A.K. Banerjee, the current manager of raw materials developement at TPM. The corporation will use the concept of 'core' and 'halo' plantations. The 'core' area will consist of commercial forests where the trees and their maintenance will remain under the direct control of the WBPWDC. But to prevent people living in the surrounding 'halo' areas from seeking their daily fuel and fodder needs from the 'core' forests, intensive social forestry practices



will be promoted for the development of forests on private ands in the 'halo' areas.

This would reduce the need for watch and ward staff in the core forests, explains Banerjee who believes that full scale watch and ward will prove prohibitively expensive and would be quite impossible. In the core forests, villagers will participate by putting in their marginal and waste lands for which they would be paid an annual rent and a quarter of the ultimate produce. Besides this, the villagers will earn wages by offering their labour for planting, weeding, bunding and other operations.

WBPWDC points out that this scheme will not only bring wastelands into productive use but it will also ensure the necessary participation and cooperation of the villagers, who will be given training and education in social forestry; local youth clubs and voluntary agencies will be given seedlings of fast-growing species. "We have an understanding with the West Bengal Forest Department that they would take up the social forestry programme in the 'halo' area with our assistance and with the involvement of voluntary agencies. Extension expertise and a pro-people's attitude are not the strong points of a forest official's training. We hope this handicap will be overcome with the involvement of voluntary organisations and of TPM itself," argues Banerjee. Over the past five years TPM has distributed many seedlings for homestead tree cultivation to meet part of its raw material requirements. WBPWDC envisages converting 24,000 hectares of land into pulpwood and bamboo forests over the next five years to yield some 1.3 million tonnes of raw material in 14 years. The corporation is expected to make profits and be independent of subsidies.

## The Spreading Rot

The Food and Agriculture Organisation (FAO) estimates that illegal timber felling in some countries is over 30 per cent of officially recorded production. Nobody has the precise figure for India but the scourge was highlighted as never before in early 1983: Himachal Pradesh Chief Minister Ram Lal resigned when Chief Justice Vyas Dev Misra, on receiving an anonymous letter, reopened a timber smuggling case involving a forest contractor Mast Ram Tanta, and charged that the chief minister's son Jagdish Thakur and son-in-law Padam Singh were enmeshed in the scandal.

Mast Ram Tanta—a resident of Jubbal, Ram Lal's home town—used a forged permit to transport 1,000 logs worth Rs 2 lakh across the state. He was fined Rs 500 as punishment. However, Misra received an anonymous letter pointing to the "unholy haste" in which the case was disposed off. It transpired that the trucks in which the logs were ferried belonged to the chief minister's son and son-in-law, and the powers that be had moved quickly to stifle the case. And an uncomfortably zealous officer S.D. Minhas, then deputy director of enforcement, was given an obscure posting in Dharamshala. Misra accused the Directorate of Enforcement of trying to "bury the case fathoms deep."

Virbhadra Singh, who had earlier urged the use of the Indian Penal Code and the National Security Act to deal with timber smuggling, became chief minister. He had also suggested that special courts be constituted, but as he was elected from Jubbal he, in the words of a national daily "became suddenly silent and did not utter a word against the forest offenders". A prudent move in a state whose forests play a big role in politics, with 80 million cubic metres of wood valued at over Rs 3,500 crore.

The situation in other states, though less dramatic in its impact, is no less serious. In Jammu & Kashmir, the government ordered that those found felling trees illegally be shot at sight, a laughable edict in a state where the nexus between the forest barons and the ruling party is all too well-known. In West Bengal some 5,000 offenders were arrested in 1982, but only a few were prosecuted. In Meghalaya, the tribal owners of trees have become ideal fronts for non-tribal contractors—in the Garo Hills, the number of officially licensed timber contractors has shot up from 15 to almost 800 in a few years. In Orissa, timber racketeers use permits issued to tribals to make away with huge quantities of timber looted from the reserve forests.

Madhya Pradesh is probably the most affected. Officially, over Rs 2 crore worth of timber was stolen last year from its forests. Bilaspur district headed the table with Rs 59 lakh worth looted in 1981 and 1982. But unofficial sources put the loot at an incredible Rs 50 crore, annually. Foresters in Hoshangabad district say that the timber lost there every year is easily worth more than Rs 3 crore.

This is despite the state's forest army of about 35,000 as twenty were killed in one year and 600 beaten up in attacks by smugglers the state government announced in 1983 that it would make available 200 guns to forest employees in sensitive forests. Political patronage helps smugglers. In one year alone, 42 out of 57 rangers in Hoshangabad district were transferred to "lucrative posts". The tribals, as always, are roped in by the smugglers: they are asked to make a deep cut all around the base of a tree, which then dies within a week, and can be felled, chopped to pieces and carried away to waiting trucks as perfectly legal headloads.

The position in neighbouring states is similar, though on a smaller scale. In Uttar Pradesh, the special forest protection force is to be expanded from 114 to about 500 but it is unlikely that this will curb the illicit timber trade, one facet of which is the khair tree smuggling across the border to Himachal Pradesh and Haryana. One tree with a girth of about 35 cm fetches Rs 6,000. The illicit trade in Bihar is estimated at Rs 5 crore a year. In Haryana, the Haryana Forest Development Board says that at least 30,000 trees have been illegally felled in Ambala and Morni forests in the recent years. Depressingly similar complaints come from Maharashtra and Gujarat.

Kerala's creaking coalition government is destroying forests in its own unique way. It has regularised illegal occupation of prime forest land in the Western Ghats simply because not doing so would have meant losing the crucial support of political parties in the coalition.

Hundreds of hectares of evergreen forests in the Western Ghats are being encroached upon as a continuing process by land hungry peasants from the plains of central Travancore. And the political parties claiming their support have been able to legalize such illegal occupation and grant them 'pattas'.

The government of Kerala fixed January 1, 1977, as the cut-off date for regularizing illegal occupation of forest land. The Kerala Congress (J) having a strength of seven in the 141-member Assembly, enough to topple the Ministry, served an ultimatum on the coalition Government on the eve of the 1983 winter session of the State Assembly that it was no respecter of the Cabinet decision fixing the cut-off date for forest encroachers.

The Chief Minister, K. Karunakaran, made an unscheduled visit to New Delhi and managed to meet Mrs Gandhi amidst her preoccupation with the Commonwealth Heads of Government Meeting, to get her approval.

Despite the ecological danger, the Prime Minister's Principal Secretary, P.C. Alexander had to placate Revenue Minister Joseph—whose Kerala Congress (J) has seven members in the coalition—over the phone and promise regularisation of encroachments. On March 25, 1984, it was announced that Mrs Gandhi had permitted the Kerala government to give title deeds to about 1.8 lakh encroachers on 50,000 hectares of forest land. As a leading newspaper commented: "And so politics triumphed over ecology . . . ."

Control over large tracts of forest lands by private companies will inevitably rebound on the needs of the local villagers. Given the present population density in the country, there are no large tracts of land which are not being used by the rural population to meet its fuel, fodder and other critical needs. Industries will naturally tend to close these for rural use, and a paper from the Indian Institute of Science points out this could lead to serious conflicts as happened with the West Coast Paper Mills in Karnataka when it tried to fence off large parts of its concessional areas to protect the bamboo crop. The paper mill had to finally remove the fencing in response to local political pressure.

Moreover, as labour constitutes the major cost of afforestation, industries will definitely prefer capital-intensive technologies for tree farming and thereby reduce the potential for employment generation. Industries will also tend to bring cheap labour from outside the region to keep local wages down and thus induce migration and increase social tensions with the local populations. This is a common practice amongst forest contractors in the Himalayan region who regularly hire cheap labour from other states. Finally, giving control over such large tracts to industry could recreate feudal political pressure in a form that the country has not seen for a long time now.

The other alternative is for governments to provide degraded forest lands for tree planting to families of landless labourers, headloaders or other such people from the economically weaker sections of the society or to their cooperatives. Land could be leased out to individual families on the condition that they will grow trees on it. But if even 20 million hectares of degraded forest land were so distributed with each landless family getting 2 hectares to 4 hectares of land some 5 million to 10 million landless families or 25 million to 50 million people would benefit and many more families would get employment. There is absolutely no other programme that attacks such major problems as landlessness, rural unemployment and ecological regeneration at the same time.

**Trees for the landless**

The World Bank has accepted in a recent review of its social forestry programmes that it has failed to meet the fuel and fodder needs of the landless poor, who own no assets whatsoever. Their salvation lies, the review says, in the general economic and social development of the country and points out that one way to help landless families may be to ensure that degraded forest lands are allotted to them.

Indian industrialists interested in afforestation are generally sceptical that such an approach will work and point to numerous legal, administrative, financial and political hurdles. Bombay industrialist Shankar Ranganathan says that the success of any scheme that distributes forest land to the landless "will depend on the amount of supervision actually provided and protection of the poor farmers from the predatory local 'dadas' (godfathers)".

Nanubhai Amin of Jyoti Limited asserts: "Past experience indicates clearly that even if the land is given to the tribal people, no afforestation is done. This is so because it requires economic, technical and managerial resources which are simply not available with the poor. Secondly, income from afforestation can start accruing only after five to seven years. It is impossible for poor people to find other resources to sustain themselves for this long period. This results into keeping land fallow after one or two years of extremely marginal cultivation."

There can be no doubt that there will be a number of problems in undertaking a vast forest redistribution scheme. Firstly, landless farmers could be tempted to plant short-term food crops rather than long-term tree crops. But thousands of farmers are already readily planting trees in response to the high prices of wood. The key point is to ensure that farmers will get a remunerative price for their wood. There should, therefore, be price support mechanisms in case there is overproduction. In fact, the Planning Commission's Fuelwood Study Committee had recommended that prices for wood be made a part of the duties of the Agricultural Prices Commission. Even more

**Paper Tiger**

If ever there was a chaos of priorities, it is this. Even as the acute nationwide shortage of firewood and green fodder makes crop residues extremely important for fuel and fodder in India's villages, the government promotes industries based on these valuable crop residues. Little biomass can qualify as crop 'waste', as almost every part of a crop plant is used as fuel, fodder, fertiliser or thatch. Yet the government has provided excise tax rebates and other incentives like import of second-hand machinery from abroad to manufacturers who set up paper mills based on so-called unconventional raw materials like rice wheat straw, grass and bagasse.

About 15 per cent of the paper manufactured in India is made out of straw. The glib justification for the plants is that some 150 million tonnes of rice and wheat straw are produced every year—vast unused reservoir of agricultural wastes. But the little data available clearly shows that straw is not surplus in most areas: straw consumption per head of cattle is about one tonne per annum and there are over 200 million heads of cattle. And firewood shortages, especially in highly agricultural areas with a shortage of trees, are made up by crop residues and dung—crop residues processed by an animal.

There are other aspects to the problem. Straw prices shoot up after a paper mill is set up. Landless and marginal farmers who earlier got straw free from the richer farmers are left out in the cold because the latter have now found a lucrative market for their 'wastes'. The price differences of rice straw is Rs 300 per tonne between those states that have paper units and those that do not. In South Gujarat, with its concentration of small paper mills, straw is now available for Rs 400 a tonne.

A recent study by former FAO expert, B.V. Krishna Murti on Eco-development in southern Mysore points out that close to Nanjangud town, along the banks of river Kabini, several paper manufacturing units have been set up and others are in the process of construction. The government has already endorsed the use of crop residues, and one of these paper mills is using ragi straw, a vital cattle feed, already in short supply. Another is using elephant grass and paddy straw which, too, are in short supply and the paper mills' consumption is pushing up prices, causing severe hardship to the poor farmers of the region.

Dr Krishna Murti points out that the existing cattle stock in the region is half-starved and improving animal feed supplies is a matter of great urgency. With additional areas scheduled to come under irrigation in coming years, there will be a significantly increased demand for adequately fed cattle stock.

Most small paper mills are facing serious problems because of high raw material prices and various other reasons. Some 42 small mills closed in late 1983 and none of the small units have been servicing their debts to the financial institutions in the past couple of years. Of 118 new paper units financed by the Industrial Development Bank of India since 1980, 40 have closed down. The remaining are clamouring for a total relief from excise duty.

It is the close nexus between the government, industrialists, and big landlords, often abetted by unthinking scientists, that important is that the poor tree farmers be compensated on a yearly basis instead of being asked to wait for six years. Many private companies in West Bengal and Karnataka are already encouraging homestead tree cultivation by offering farmers annual payments.

Schemes could also be thought of in which the companies are forced to work with landless families to get their raw materials. The Department of Environment recommends that the industry getting degraded forest land for planting trees should not only guarantee employment but also participation as shareholders to the local population. "Forest departments, local people and the relevant industry could form a corporate body to manage such plantations," says the department but has shown little courage to push this recommendation.

There is no doubt that many political problems could crop up. Once it becomes known that large tracts of land are to be distributed to the landless, local politicians and vested interests will do their best to corner them in the name of the landless. But the political problems can be solved, as can the technical, managerial, financial and legal problems, only if there is the political will to do so. If not, the problems in getting a scheme that benefits the landless accepted and then overcoming the problems in getting such a scheme implemented are inevitably going to be insurmountable. The problem, like every other social question in India, is political.

results in such anti-poor policies. What is happening in Sirsa—a new district in Haryana, carved out of Hissar district only in 1975 clearly shows this trend. Almost all the industry in the prosperous, highly irrigated district, whose total population in 1981 was seven lakhs, is agro-based. Since 1970 many ginning factories and rice shellers have been set up. To those have been added in the last two years seven straw board mills using rice husk and straw, one small paper mill using wheat and paddy straw and one fuel briquetting unit using rice husk and mollasses for selling fuel briquettes in urban areas. Big farmers sell their surplus crop residues to these units.

They have already stopped giving free residues to their landless labourers. An agricultural labourer's daily wages are about Rs 15 and residues are given to them as part wages. Cotton sticks of an acre are given away as wages for picking the cotton from that acre.

Yet another raw material for the paper industry is 'bhabhar' grass. A study conducted by Shekhar Singh of the Indian Institute of Public Administration shows that the Uttar Pradesh government has effectively reallocated the use of this grass to paper mills and away from the 40,000 families in Saharanpur district who produce baan, a rope used for charpoys. In the late 1970s and early 1980s, the baan workers got the grass at between Rs 800 and Rs 1,000 per tonne, through a system of contractors and middlemen, while the government was selling it to paper mills, on a quota basis, at Rs 300 to Rs 350 per tonne.

In 1982, the bhabhar trade was taken over by the newly formed Uttar Pradesh Forest Development Corporation. The corporation doled out contracts to the same big contractors and the grass was then stored in depots and auctioned in lots of 100 quintals or more. It cost the users 25 per cent to 35 per cent more than the year before. As a result nearly 40,000 baan families face starvation. Meanwhile, paper mills still get bhabhar at Rs 400 per tonne.

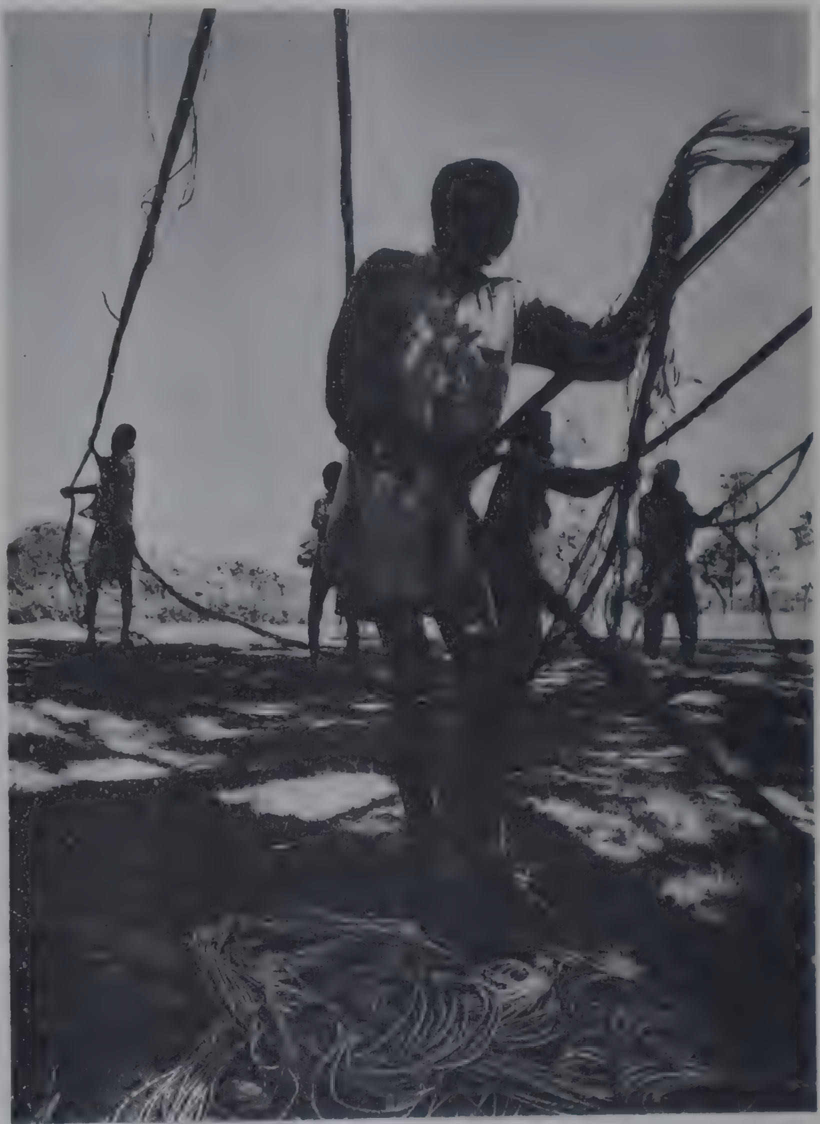
Jute sticks and mesta are other raw materials for the paper industry. There are some 2.8 million tonnes of jute sticks available every year. But jute sticks are also used extensively as fuel in energy-starved West Bengal and Bangladesh. Fortunately, jute pulp is a problematic material and use of jute sticks for paper-making will be limited in the near future.

The biggest and most acceptable raw material would be bagasse from sugar mills. Bagasse was once used extensively as fuel by villagers; now sugar mills use it as fuel and unless they are assured of cheap coal, they will not release bagasse. India produces about 15 million tonnes of bagasse annually, enough for 2.5 million tonnes of paper or about double the current production.

Recently the Tamil Nadu Newsprint and Papers Ltd , whose paper mill is expected to begin operation at Pugalur on the Cauvery river in September 1984, has taken a bold step. It will set up coal-fired boilers and supply five sugar mills with steam, the mills will release bagasse in proportion to the steam supplied. The Mysore Paper Mills in Karnataka wants to replace bamboo pulp with bagasse by setting up its own sugar mill.

The Development Council for Pulp, Paper and Allied Industries has recommended the construction of mini-newsprint mills—15 tonnes to 20 tonnes daily—close to sugar mills so that the cost of transporting bagasse is minimised. But these mills can work only during the cane crushing season which lasts for five to six months. For the rest of the year they will have to depend on bamboo, straws, jute sticks, rags or waste paper. Water pollution in these areas will also be immense. The water pollution load from a small paper mill is equal to that of a paper mill five times larger in size.

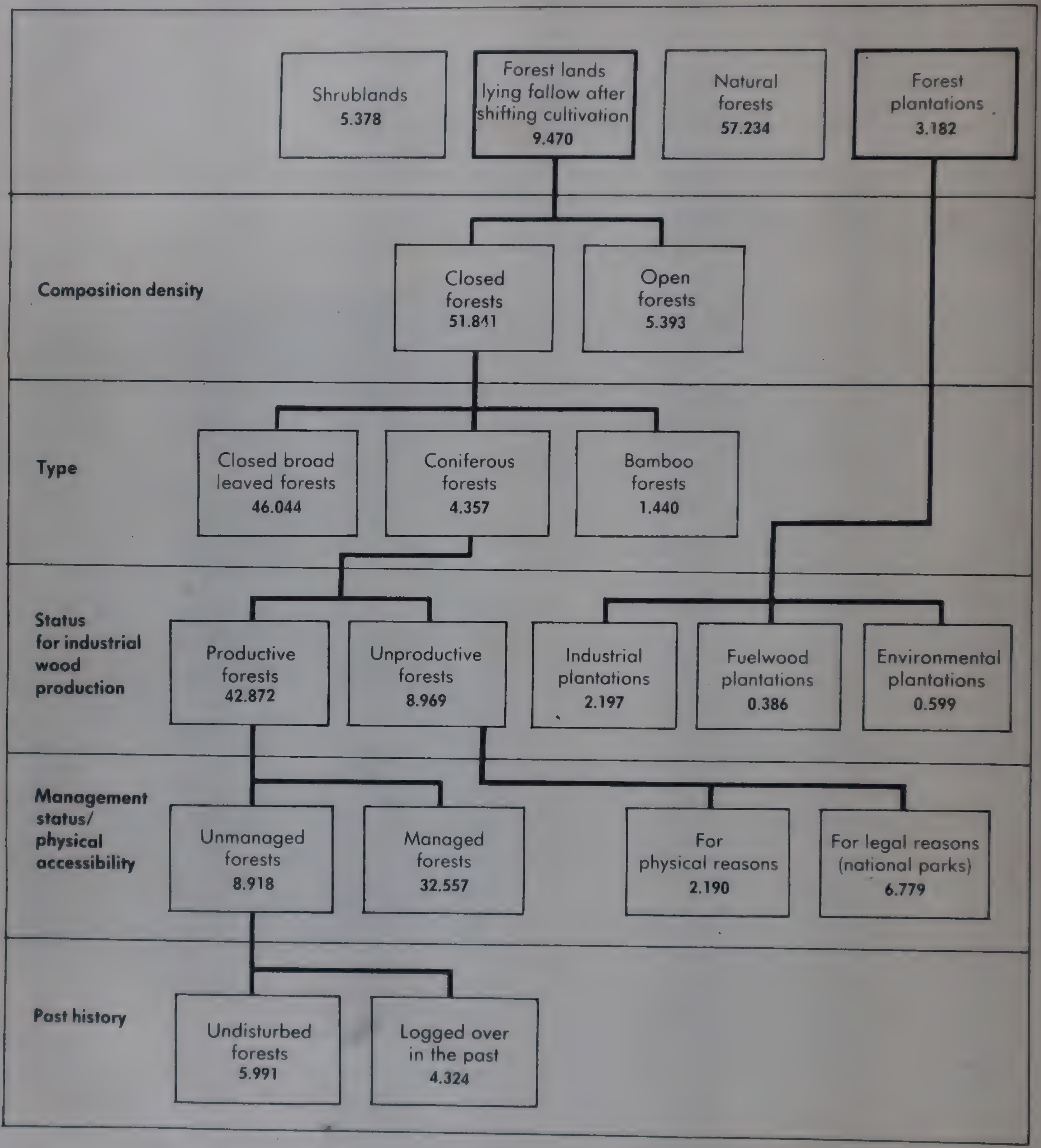
Inadequate care in obtaining raw materials for paper production could seriously affect the country's environment and make all the poor who critically depend on the environment poorer. The paper industry's needs can be met only after proper priorities have been set for biomass use in society.



**North India's ubiquitous charpoy is made from baan ropes. But paper mills now get bhabhar grass before baan workers. (Pramod Pushkarna/ India Today )**

## Status of Forests in India in 1980 (in million hectares)

**Total forest area: 75.268 million hectares**


Shrublands 5.378
Forest lands lying fallow after shifting cultivation 9.470
Natural forests 57.234
Forest plantations 3.182
Composition density
Closed forests 51.841
Open forests 5.393
Type
Closed broad leaved forests 46.044
Coniferous forests 4.357
Bamboo forests 1.440
Status for industrial wood production
Productive forests 42.872
Unproductive forests 8.969
Industrial plantations 2.197
Fuelwood plantations 0.386
Environmental plantations 0.599
Management status/ physical accessibility
Unmanaged forests 8.918
Managed forests 32.557
For physical reasons 2.190
For legal reasons (national parks) 6.779
Past history
Undisturbed forests 5.991
Logged over in the past 4.324

The above figures simply show the administrative classification of forests. In reality satellite data of 1980-82 shows that closed forests covered only 36.02 million hectares and open forests 10.06 million hectares; that is, closed forests were over 15 million hectares less than estimated and open forests nearly five million hectares more. But the above classification of forests does show that the forest departments have logged or have logging plans for nearly two-thirds of the closed forest area (as over estimated by them). Less than 30 per cent of the closed forest area (again as over estimated by the forest departments) today escapes logging.

Source: Food and Agriculture Organisation based on data supplied by Government of India

# BASTAR : THE VANISHING FRONTIER

Bastar is the last major frontier in India's tribal heartland. It is the third largest district in the country, slightly larger than the state of Kerala with an area of 39,060 sq km yet its population, according to the 1981 census, is just over 1.84 million—two thirds of this being tribal, with the Gonds in an overwhelming majority. There are only five towns and the total length of surfaced and unsurfaced roads is just 3,300 km—the surfaced road length is less than that of Bombay city. Only 270 of the district's 3,683 villages are connected with all-weather roads. The sole railway line is for goods traffic, carrying iron ore from Bailadilla to Visakhapatnam on the east coast.

Physiographically, Bastar is part of the Dandakaranya region. Its major natural divisions are the northeastern plains of Kanker drained by the Mahanadi river; the Bastar plateau sloping from the northwestern corner to the eastern boundary; Abujhmarh; and the hills and plains of south Bastar. The Indravati river rises in neighbouring Orissa, flows east to west, dividing Bastar into northern and southern halves. The Sabari river, which flows through south Bastar is the other major river. The district has a large number of perennial and seasonal streams.

Bastar is rich in resources, although not as rich as it once was. It was known as 'Banstari'—the valley of the bamboos—and bamboo still forms about 20 per cent of its forest stock. It has the largest expanse of moist deciduous forest in India, with sal, teak, laurel and 15 other species. The district has 10 per cent of India's iron ore reserves, a billion tonnes of cement grade limestone deposits, significant reserves of dolomite — used in steel manufacture — and ample stores of tin ore. Besides this, it has vast unexplored deposits of bauxite, quartzite, manganese, sulphur, copper and lead-zinc ores. Last, but certainly not the least, Bastar's hydroelectric potential is estimated at an enormous 2,000 mw and over.

Such riches have made Bastar a paradise for exploiters—who are rapidly transforming the region into something less than a paradise. Take the case of the district's prime natural resource, the forests which cover 54 per cent of its area, and which work out in quantity to 1.14 hectares of forest per person, well above the state and national averages of 0.3 hectare and 0.11 hectare respectively. At present, about four-fifths of Bastar's forests are estimated to be adequately stocked or at least have effective tree cover, but the rest—about 400,000 hectares of mostly undemarcated protected forest lands—is thoroughly degraded and, indeed, has only a bare minimum of topsoil.

Bastar's forests yield a variety of minor forest products (MFP), that are collected by tribals and sold. Until recently only private traders appreciated the value of MFP. But in the mid-seventies, the Madhya Pradesh government nationalised the trade in tendu leaves, harra (myrobalan) and sal seeds. Tendu leaves are used by the beedi industry and tannin is extracted from harra for use by the leather industry. Sal seeds are used for extracting oil, which is used by soap makers, Cadbury Chocolates Ltd for making chocolates and also exported to Japan and West Germany. In 1981-82 the Jagdalpur forest circle earned a net revenue of Rs 1.46 crore from the MFP trade. This figure rose to Rs 1.88 crore a year later.

### Degradation

Vast tracts of degraded forests can be found around the few urban centres such as Jagdalpur, Kanker and Kirindul. "From Jagdalpur to Chitrakoot falls and for about 40 km on the Jagdalpur-Dantewara road, the forests are almost blank," says a former conservator of forests for the Jagdalpur circle. No wonder: in the early seventies, the recorded annual production of Bastar's forests was 120,000 cum of timber and 1,800 notional tonnes of bamboo. By 1980-81, the district produced 250,000 cum of timber, 167,400 tonnes of firewood and 48,600 notional tonnes of bamboo.

The causes of the deforestation are many. The British, in their time, blamed it on the shifting cultivation practised by the tribals. By the late forties, the tribals had given up this lifestyle and it is now practised mainly in remote areas like Abujhmarh. The British appetite for teak also led to widespread and indiscriminate felling; in addition, the sal forests were fashioned into sleepers for India's growing railway network—even today, almost half the sal for railway sleepers comes from Bastar. World War II brought fresh pressure with the increased demand for hardwood.

Today, the rape continues. The neighbouring districts of Durg and Raipur, with rapidly growing populations and industries, provide a convenient incentive for unchecked felling. The national hunger for fuelwood is another

factor—truckloads of fuelwood can be seen heading out of Bastar and forest officials expect that the district will soon be supplying fuelwood to places as far away as Delhi.

Some of the tribals are hand in glove with corrupt officials. They get around the ban on felling healthy trees by cutting deep gashes in the trunk to starve them of nutrients, and they collapse during storms. The scarcity of firewood is already being felt: prices of commercial firewood rose 200 per cent between 1975 and 1983 in the Jagdalpur circle, and even those at nistari depots, the 'fair price shops' for wood, rose by 130 per cent.

The tribals are easy prey for rapacious contractors and traders. In October 1959, legislation conferred ownership rights to trees on all landowners. Timber contractors flocked to Bastar and bought millions of trees from tribals for a pittance and, in the process, huge tracts of government forests were destroyed.

### Planned destruction

Development is another great destroyer. Between 1956 and 1981, 125,483 hectares of forest lands were transferred to various development projects, according to a Bastar forest department publication. This is almost a third of the total forest area lost in the district. Another 31,000 hectares could be swallowed up by hydroelectric and other schemes.

Sometimes, the projects don't work out, but the damage is virtually irrevocable, as in the case of the 1958 Dandakaranya project for rehabilitating East Pakistan refugees. It was spread over two zones in Orissa and Bastar each and over 60,000 hectares were allotted by the state government. In the Kondagaon zone in Bastar, thousands of hectares of sal had to be cleared. To add insult to injury, the project was wound up in this area without the promised benefits going to either the new settlers or the tribals.

The Bailadilla iron ore project is another example. It was conceived of as a foreign exchange earner—the iron ore goes to Japan—and 14 deposits of high-grade ore were identified along the 48 km length of the Bailadilla range. The complex boasts of Asia's largest iron ore mine and is the largest foreign exchange earning unit in India. In 1982-83, iron ore production was 5.2 million tonnes, up from 3.3 million tonnes in 1970-71. Foreign exchange earnings rose from Rs 23.70 crore to Rs 116 crore in the same period and royalty accruing to the state government increased 450 per cent.

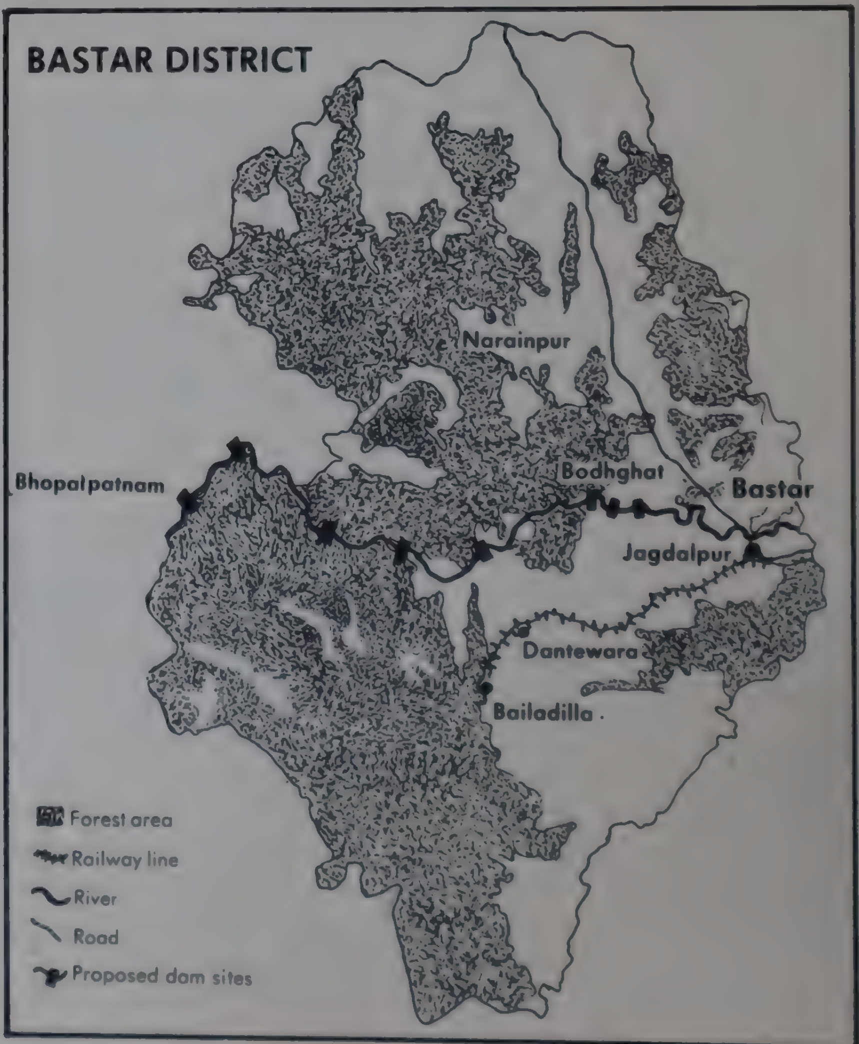
Forests sustain Bastar's tribal economy. (Ravi Chopra)

Inevitably, there were losers. The jungles around Bailadilla abounded with unusual flora and fauna including big animals like antelope, bison, deer, bears and tigers. But now the forests are gone, the water is polluted and the air is heavy with dust. Instead of trying to conserve forest wealth by using careful layouts, cutting and filling one block at a time, contour bunding to prevent soil erosion and reforesting, there was wholesale clearfelling of the jungles. With their most important economic resource destroyed and few of them employed in the mines, the once-proud Maria tribals of this area are a demoralised lot. To feed their families, many tribal women have been forced into prostitution.

Since 1968, ore fines from the screening plant at Kirindul have been dumped into the Sankhini river, turning it into a mass of red slime and some 40,000 tribals living in 51 villages have been deprived of clean water to drink and wash in. "If you have to kill us you may as well line us up against a wall and get rid of us in one go," a tribal told a journalist. But filtered water is supplied to the 20,000 inhabitants of the mining township at Kirindul.

Now the tribals are thwarting attempts to build a tailings dam by demanding a high price for their land threatened with submersion. They remember all the earlier broken promises of alternate land and employment. "Short of taking over the land by force, it is unlikely to be acquired .... The takeover will probably be brutal," warned 'The Times of India'.

A fresh controversy arose in June 1982 when the National Mineral Development Corporation (NMDC) disclosed plans to



tart a dolomite mine in Jagdalpur tehsil. The proposal also ncluded an ore-dressing plant and a railway line through eavily forested areas. The mining lease application sought n area which included 775 hectares of the Kanger Valley Reserved Forest and a future option for an additional 1,675 ectares in the same forest. Over 300,000 sal trees would be destroyed in the initial area alone.

Local tribals and members of the Jagdalpur-based Bastar Society for Conservation of Nature (BASCON) protested igorously. The area is dense mixed forest with a heavy concentration of sal trees. Ironically this is next to the pine plantation project which was successfully stalled by BASCON. The mines would also pose a severe threat to the Kanger Valley Forest Sanctuary, one of the earliest biosphere reserves in the country. Bastar's forest department, tired of seeing its domain whittled down by the development projects, also objected. As a result, the state government turned down NMDC's application and offered it alternate sites in Bilaspur district. NMDC officials may still refer the matter to the Central government.

Another threat to Bastar comes from several dams that are being planned. Local forest officials are unhappy with the proposed 500 mw Bodhghat hydel project which will be built across the Indravati river by 1989-90. The project will submerge 12,640 hectares of which 5,676 hectares is forest land, most of it covered by dense thick jungle. According to the 1971 census, some 8,350 people from 34 villages will have to be rehabilitated. The environmental and ecological aspects of the project were cleared by the Central government in 1979. The state's own wildlife officials claimed that no rare species of wildlife exist in the area. But local foresters say that no serious environmental impact analysis has been conducted.

The Planning Commission cleared this project in 1979 and the World Bank agreed to provide 50 per cent of the total cost of Rs 413 crore. It is a measure of the planners' blindness that a project that will adversely affect thousands of people does not have any rural electrification component: all the power will be fed into the state grid and possibly be used for the Bailadilla complex. A superintending engineer at the project site admitted that the tribals to be ousted were unhappy about the dam's location and had not been involved in the planning process at all.

The Bodhghat dam is just one of nine hydel projects to be built along the Indravati in Bastar. Once these projects are completed, the free-flowing Indravati will be lost forever, replaced by a cascade of dams. The life of the Bastar tribals will never be the same. Baba Amte, the well-known social worker, has launched a campaign against two other dams—Bhopalpatnam and Inchampalli—which too will affect Bastar.

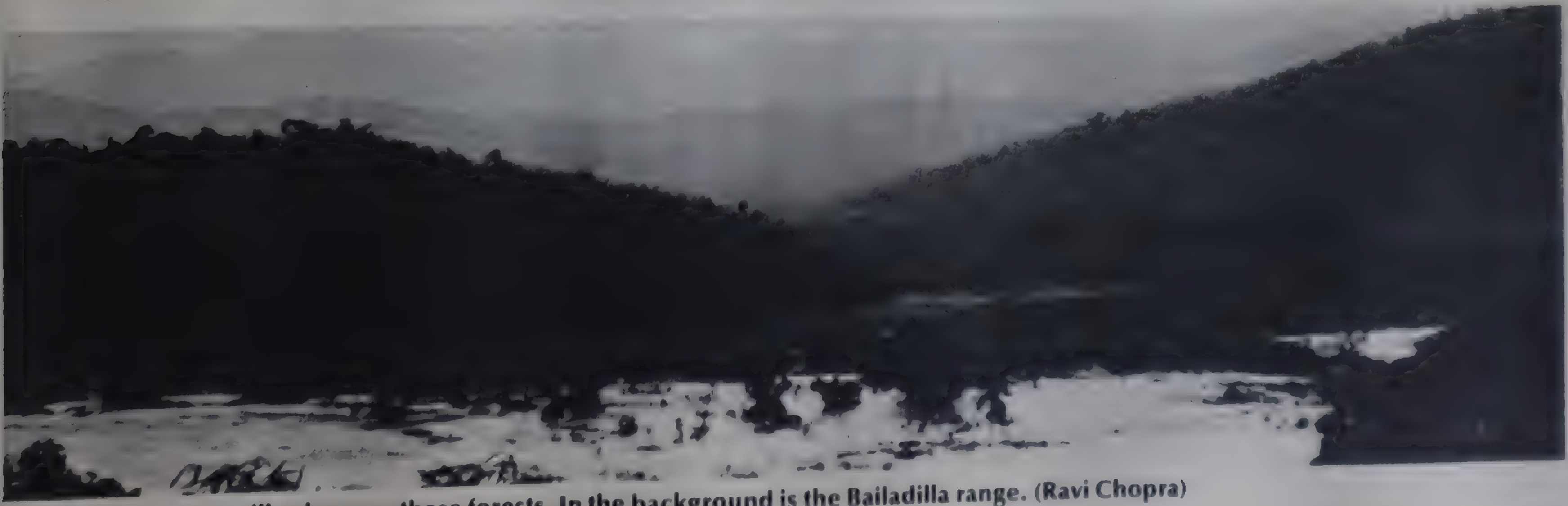
## Forest Management

In 1946, Dr H. Mooney, forest adviser for the Eastern States Agency, wrote: "(Bastar's) importance lies in the vast expanse of its forest and in the large forest revenue, but of scientific forestry there is almost none. Hitherto the department has been little more than a revenue collecting agency . . ." Today, a generation after independence, this attitude is unchanged. Revenue from Bastar's forests has multiplied 10 times over the last decade—the forest revenue from the entire district is over 20 per cent of the state's—but of planned exploitation there is little.

Soon after the formation of the Bastar forest district in 1962, the forest department set about preparing plans to exploit its forest wealth. According to the planning document prepared by the National Commission for Applied Economic Research (NCAER), Rs 2 crore was spent on preliminary surveys and feasibility studies. The Pre-Investment Survey (1966-68) data on Bastar's forest resources were so impressive that local, state, national and international agencies, including the FAO, World Bank and the Swedish International Development Agency (SIDA), prepared a variety of proposals.

A number of wood-based industries were proposed for Bastar—total investment Rs 200 crore, or half the state's proposed outlay in forest-based industries—including export-oriented and rayon grade pulp mills, sawmills, papermills, plywood, hardboard and particle board factories. Intensive Forest Management Plans (IFMP) were to be drawn up so that timber production was geared to the needs of these industries. According to the NCAER report, the objectives of the IFMP were "concentrated fellings and replacing the original crop with sal natural regenerations and plantations of teak and pine over 1.5 million hectares". The ultimate objective was to enhance the productivity or the revenue-yielding potential of almost two-thirds of Bastar's forests. In the process, the nature and functions of the forest would be drastically altered, to the disadvantage of the tribals.

In 1974-75, working plans were drawn up for forests near



The Bodhghat dam will submerge these forests. In the background is the Bailadilla range. (Ravi Chopra)

Jagdalpur and Barsur covering 515,000 hectares. Later in 1978-79, plans were prepared for west Bastar. But no industries as proposed in the IFMP were established in Bastar. The forest department merrily continued intensive extraction and sale of choice timber till new working plans were formulated in June 1983. "But working plans require a lot of preparation. Therefore the present working plans may continue with little modification," says Vishwakarma, a retired forest officer and president of BASCON.

### Plantation programme

The second aspect of the IFMP was to grow commercially valuable species through a plantation programme. Under the Bastar pine plantation programme 40,000 hectares of deciduous forest, predominantly sal, were turned over to the Madhya Pradesh Forest Development Corporation in 1976 for clearfelling and raising tropical pines for a paper industry. This programme was strongly opposed by local tribals and environmentalists. BASCON members pointed out that in addition to depriving the tribals, the pine plantation would harbour no plant or animal wildlife and that fallen pine needles would be a fire hazard. "Pine related pests will proliferate, demanding extensive use of pesticides, and polluting the air, soil and water," warned Sharad Verma, a BASCON founder-member and local journalist.

Despite the protests, a trial project spread over 3,100 hectares of rich sal forests near Jagdalpur was started with a loan of $8.2 million from the World Bank. The tribals and BASCON members wrote petitions, demonstrated, and mounted agitations. When all else failed, they set the pine trees on fire. An alarmed Mrs Indira Gandhi ordered the project suspended. By 1983, most of the surviving pine trees were attacked by a fungus and had to be destroyed. And the whole project was abandoned.

The conversion of sal or mixed forests into monoculture plantations is state policy. Every year, the Madhya Pradesh Forest Development Corporation grows about 12,500 hectares of teak plantations in this manner and they are also raised in Bastar. But achievement is far below projections. Similarly, eucalyptus plantations in south Bastar have been total failures, with a survival rate of barely one per cent. This approach to regenerating forests has been criticised by many forest officials as ecologically harmful. It is also anit-tribal because they are generally denied access to the plantation area.

### Social forestry

Since 1976, social forestry programmes have been taken up in Bastar. Derelict patches of forests near villages are being rehabilitated by planting fruit and other economically valuable species. Under the Panchvan scheme, these areas will be managed initially by the forest department and then handed over to the villagers. They are expected to become buffer zones between the villages and reserved forests.

In this context, an earlier scheme is worth mentioning. In 1935, an area of approximately 50 sq km near Jagdalpur was selected for growing sal trees to more than 3.5 ft girth in 30 years. The land was heavily grazed, cut and was turned over to 41 neighbouring villages. The villagers were free to collect MFP and meet their nistar requirements on a sustained yield basis. The project was very successful, but never followed up in other areas.

**A potter at a weekly bazar in Jagdalpur. (Ravi Chopra)**

## Islands in the Stream

Andaman and Nicobar are a group of more than 300 islands, islets and reefs in the Bay of Bengal, about 1,200 km away from Calcutta and Madras. They have a population of 1,88,254. The islands are the country's last contiguous tract of low-lying tropical rain forest — as much as 86 per cent of the total land area of 8,293 sq km is classified as forest. Tropical rainforests, all over the world, are being wiped out at a staggering rate of 21.6 hectares a minute and are expected to be totally obliterated by the end of this century. In India apologetic pockets of these forests remain in the Western Ghats and the Northeast.

Rainforests are a complex and fragile ecosystem. Virtually all the nutrients are found in living vegetation, not in the soil, and when the forest is cut down the thin layer of topsoil quickly washes away, leaving behind hard-baked clay or sand that is good for only a crop or two. Then the land becomes a virtual desert. The forests are also an important source and reservoir of fresh water. The International Union of Conservation of Nature (IUCN) consultant D.N. McVean, is his report for the Government of India noted "were this forest cover to be moved, the water available for human use would be significantly reduced for one third of the year and catastrophic annual drought might become commonplace." Without the rainforest canopy to protect the soil torrential rainfall would wash away the topsoil of the islands.

These rainforests are the richest expression of life that has evolved on this planet. The biological wealth of the Andaman and Nicobar forests is unsurpassed. For instance, out of 15,000 species of flowering plants in India, 2,200 species are found here, and as much as 10 per cent are found only here.

Today, though relatively undisturbed, the forests are in danger from a growing population and intensive forest activities. Dr Sathis Chandran Nair and Dr S. Santhi prepared a detailed report on the environmental status of these islands and found that the forests had been fragmented and degraded. In north Andamans, the recorded 96 per cent forest had been reduced to barely 21 per cent. In middle Andamans they had been reduced to 29 per cent and in the south Andamans all the forests were overworked. The only intact stretch found was in the Jarawa reserve.

In 1983 a new approach to social forestry was taken up in Bastar, as well as in other parts of Madhya Pradesh. Under the Hitgrahi scheme, the 60 poorest families of a village are selected, and each given a hectare of derelict land for fruit trees. The forest department provides saplings, fencing and any other required resources. The families are paid a monthly stipend of Rs 50. The family doesn't own the land but can sell all produce. These families will receive a hectare a year under lease up to a period of 10 years. Each year 60 new families will be added. If any family is found to be negligent, it will lose the lease. The selection is made in consultation with the villagers.

The reception to the scheme has been mixed. Residents of a village near Jagdalpur, while enthusiastic, felt that 10 hectares per family was excessive. The recipients felt that Rs 50 per month was too low and also feared that the land would be taken back once it became productive.

## Wildlife

The jungles of Bastar once teemed with a wide variety of wildlife, But progress has been cruel to the animals who survive in the remote areas, particularly in west and southwest Bastar.

Between 1981 and 1983, the Madhya Pradesh government created four wildlife reserves: Indravati National Park (1,258 sq km); Kanger Valley National Park (200 sq km); Pamed Wild Buffalo Sanctuary (262 sq km); and Bhairamgarh Wild Buffalo Sanctuary (139 sq km). The wild buffalo has been declared a protected species. Other big game animals protected are tiger, panther, bear, gaur (Indian bison), barasingha (swamp deer), chowsingha (four-horned antelope), sambhar, cheetal, nilgai, bhekri (barking deer), python, crocodile, flying squirrel and wild boar.

Among the vast variety of birds in Bastar are the hill myna and the bhimraj or the raquet-tailed drongo. The hill myna, a superb mimic of the human voice, is native to Bastar. The bhimraj is as large as a magpie and its huge colourful feathers make it a popular pet among the Abujhmarias.

By establishing game preserves, the government has once again ignored the tribals. The Indravati National Park, for example, has affected the lives of about 5,000 tribals because all public rights, including the right to gather forest produce, have been abolished. Arrangements to provide them with alternatives have yet to be made and tension has been mounting. Meanwhile, local forest officials appear to be more concerned with making the Indravati National Park a major tourist haunt. "Indravati will surpass Kanha", said a senior local forester, referring to the state's largest and most well-known game park. That is a telling indication of the government's priorities.

An area of 1,149 sq km has been officially deforested since the earliest settlement. In 1980-81 the timber extracted by various agencies brought to the forest department a revenue of Rs 514,025 lakh, or 87 per cent of the total state revenue. Since then the forest department has increased the quantum of timber exploitation. Eight major forest-based industries are at work, including the Wimco Match Splint Factory, the Jayshree Timber Products Ltd and the Andaman Timber Industry. In recent years smaller forest-based industries have proliferated, marked by the entry of large business houses. The forest department considers the current extraction of 1.5 lakh cum of wood to be less than half the potential yield. To step up the pace the Forests and Plantations Corporation was established in 1977.

Demands from the wood-starved mainland have escalated. Already Tamil Nadu gets 50 per cent of its timber from the islands. In 1982 a paper mill owned by the Andhra Pradesh government and financed by the World Bank was to be set up in Kakinada and the wood for this was to come from the Andamans but the Department of Environment intervened to stall the proposal.

Current working plans are based on data collected in 1948 and do not recognise forests lost due to the influx of people after independence and the qualitative degradation of forests during the '60s and '70s when accessible and well-stocked areas were overworked. Also, the possible annual yield is based on a total stock assessment assuming 86 per cent of the land as under forest. But only 32.6 per cent is exploitable forest, the rest reserved either for tribals, or for protection belts along the coast or blank areas (rock or reef). Today, according to the report, "the quantum of extraction is influenced, more by the demand from the industries than what the forests can actually yield. This is an extremely dangerous trend."

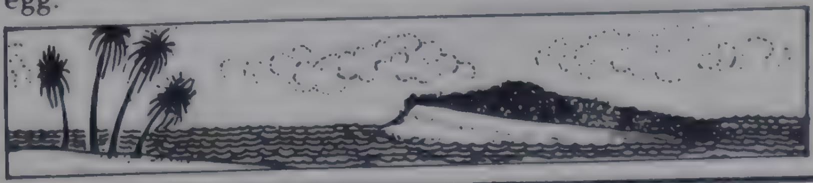
The forest department continues to compound its errors in its method of working, the first being to clearfell natural forests and replace them with plantations. As early as 1956, 99.5 sq km of teak was planted in the Andamans but the plantations failed dismally. Such failures notwithstanding, large tracts are being turned into plantations of red oil palm; 800 hectares have been so covered, with plans to increase it to 2,400 hectares. Hindustan Lever and its parent Unilever have reportedly shown great interest in this scheme.

The second management procedure is selection felling. Only "over mature" trees are removed, ignoring the fact that these trees form most of the top canopy and that removal of 10 per cent of canopy trees opens up more than 55 per cent of forest, leading to the entry of heat and torrential rain which destroys the undergrowth and washes away the shallow soil cover.

The third endeavour is to convert the tropical rain forest into a deciduous forest. Out of the 200 tree species in the tropical rainforest, only 20, mostly deciduous, have a market demand. In order to augment these the department evolved the "Andaman canopy lifting shelter wood system". Under this system, the harm done to the canopy is comparatively slow, but inevitable in the long run. What is worse is that for about 20 species of timber value a forest of far greater value and diversity is being destroyed.

The second cause of forest disruption is the government's rehabilitation programme. In 1961, a year after the settlement programme began the population of the islands had more than doubled. Gradually all flat lands were encroached upon, cleared of forests and cultivated. As individual settlements are scattered, surrounding forests get fragmented and further degraded and the loss is far greater than the area actually cleared and cultivated. In the '70s the population grew by another 64 per cent and this figure does not include the incessant stream of illegal settlers.

Agriculture is the main occupation of the present inhabitants. Tragically, what has not been understood by administrators and planners is that extensive undisturbed forests are a prerequisite for cultivation. The forests provide everything from soil and water to farming tools. Furthermore, soils, poor in nutrients, get exhausted after a few years of cultivation. Already the cultivators complain of a drop in soil fertility and decreasing yields because of falling ground water levels. It is again a case of killing the goose that lays the golden egg.



## Politics of development

Bastar is the classic colonial set-up: development means exploiting natural resources. Most proposals harp on the wealth of its resources and the lack of adequate communications to exploit them fully. The coloniser's mentality is also revealed in official documents and literature which usually describe Bastar as a "backward area" and its people as "primitive, ignorant, lazy". Outsiders often hoodwink the tribals exchanging hundreds of rupees worth of goods like tin and timber literally for a pinch of salt. For which the commissioner of Bastar division described them, in one official document, as stupid and went on to state quite stupidly himself, that "their lack of education could be improved a hundred times if railway and road communications are improved in their areas." Usually roads bring less education and more rapacious traders and contractors. Few administrators stop to realise that it is the "primitive" or "ignorant" tribals with their simple lifestyle, which puts few strains on the natural resources, who have preserved Bastar's unspoilt character. Rarely does any official recognise and respect the intuitive knowledge that tribals possess of their ecosystem.

Very often, local officials implement schemes mindlessly. Though the tribals have a birth rate lower than and a death rate higher than the national average birth control programmes are vigorously pursued. Some blocks of Bastar report the highest number of sterilisations. A report prepared by the district Family Welfare Department reveals that in the period 1965-83, as against a target of 115,880 sterilisations, 156,333 were performed. In the Emergency era, in 1976-77, 39,443 sterilisations were done against a target of 6,820. At this rate, the ultimate in colonial conquest willl be achieved before long: the tribals will be outnumbered by non-tribals from outside Bastar.

The tribals in Bastar are in deep trouble: on the one hand forced to survive in an increasingly monetised economy in which they have few skills to sell, on the other diminishing access to forests that provide them with sustenance. Some like the Bailadilla tribals become sullen and demoralised, others revolt. Bastar's tribals have risen twice this century against oppressors, and the influence of Marxist-Leninist radicals is growing. Their quick justice, often as violent retribution, is making them popular among tribals in the remoter parts of Bastar.

### Minor Forest Produce

A large number of tribals depend on minor forest produce (MFP), for survival. MFP covers everything except timber and firewood: flowers like mahua, seeds like sal, leaves like sal and tendu, resins, bamboos, lac, fruits like mango and mahua and so on. Studies in Orissa, Madhya Pradesh, Himachal Pradesh and Bihar indicate that over 80 per cent of the forest dwellers depend on the forests for between 25 per cent and 50 per cent of their food. During the lean months, mahua, mangoes, other fruits, tubers, roots, leaves, wild animals and birds are their only food for survival. In Orissa, for example, 13 per cent of the forest population depends exclusively on MFP. Another 17 per cent is landless and depends on daily wage labour, primarily collection of MFP. For another 39 per cent, MFP collection is a subsidiary occupation. In fact, the term minor forest produce is an exercise in diplomacy by terminology. For the tribals, the minor forest produce is the major forest produce. Timber is the major forest produce only for urban Indians.

One consequence of deforestation is that the availability of MFP has decreased considerably. Normally the poorest among the forest dwellers eat mahua flowers, roots and tubers during the lean months and sell fruits like mangoes for additional income. But studies indicate that the availability of mahua and other flowers and of roots and tubers has decreased considerably during the last two decades—the per capita availability of mahua flowers decreased from more than 200 kg per capita in the early 1960s to a little over 100 kg per capita today. Moreover, as the price of MFP does not keep pace with inflation, the forest dwellers are forced to consume less and sell more mahua. The weaker sections for whom this was the only protein source in the lean season are affected more than others.

Honey has all but disappeared from many forests, the availability of roots and tubers has diminished and high-vitamin foods like gooseberries are no longer accessible to the poor. The result is low nutrition, lower earnings and higher indebtedness; over 10 per cent of tribals and scheduled castes have lost their land to the moneylender in the last two decades.

The stronger and richer sections tend to grab all the MFP close to the village. Landless labourers and marginal farmers, around 25 per cent of the population, have to travel to the forests whose distance from the villages has increased from an average of 1.5 km 20 years ago to 6.5 km today. Children usually collected MFP in the past but are unable to walk such a distance, and adults are forced either to give up their daily wage labour and concentrate on the collection of MFP or not collect MFP and eat less.

Because of nationalisation of several types of MFP, there is competition between the state and the forest dwellers. Sometimes this has helped the tribals. For example, the tribal development corporations have enabled the tribals to find markets for some produce such as sal seeds. On the other hand, the produce sells for lower prices. This was brought out in a study of the events that led to the firing on demonstrating adivasis at the Simdega sub-divisional jail in Ranchi district on August 4, 1978.

The adivasis were angry because their earnings from MFP had decreased after nationalisation. As the state does not wish to suffer any reduction in its revenue it opted to reduce the price paid to the producing tribal rather than the consumer industrialist.

In this way the state blatantly discriminates against the forest dwellers. In Madhya Pradesh, for example, in 1981-82 industrialists paid the forest department 54 paise for a 4 metre bamboo, while forest dwellers paid a little over Rs 2 a bamboo supplied by the forest department. Until recently paper mills in Karnataka were getting bamboo at Rs 15 per tonne while the villagers had to pay Rs 1200. In Tamil Nadu the earnings of basket weavers have declined from Rs 8 per day in the early 1970s to Rs 6 in the early 1980s, because bamboos are increasingly sold to paper mills. What is more, the basket weavers are now subject to sudden periods of unemployment. Any new forest policy needs to reverse this anti-poor process.

## The Commercial Connection

Besides the notorious timber and paper industries there are other equally destructive users of Indian forests: the packing industry, which makes wooden cases, and the tobacco industry which uses fuelwood to treat raw tobacco. For instance, apple has been aggressively promoted as a cash crop in the three hill states of Jammu and Kashmir, Himachal Pradesh and Uttar Pradesh. However, the damage to the forests far outweighs the benefits, which accrue to a small group of prosperous orchard owners. In Himachal Pradesh alone timber worth Rs 80 crore is used every year to pack apples. This cost has been ignored.

Already the packing industry has played havoc with the forests. Currently it needs 0.5 million cum of wood, and will need 1.2 million cum within the next 20 years. In Himachal Pradesh 20 per cent of the wood felled is used for packing cases. The National Committee on the Development of Backward Areas set up by the Planning Commission has estimated that 10 hectares of timber is consumed to pack one hectare of apples. With the current 2 lakh hectares under apple in the three states, approximately 20 lakh hectares of forest will be required to feed the voracious appetite of the packing industry.

It is obvious that the demand will outstrip total production. A study by the Agro-Economic Centre, Himachal Pradesh, reveals that 1981 was the last year when supply of wood equalled demand in the state; from then on, Himachal Pradesh began to live on its capital. There is a similar scenario in Jammu and Kashmir and Uttar Pradesh. According to Harbans Singh, Agriculture Commissioner, "even a crash programme of quick-growing species would be unable to meet the demands from the packing industry till the year 2,000 by which time the forests of the states will be completely destroyed".

Further there are other crops that require wood for packing cases. At current figures of production, a total of 14 million tonnes of fruit require packing. In addition we need a minimum of 100 million to 120 million plywood chests for packing tea. This industry currently uses about 80 thousand tonnes of timber every year.

The packing cases also involve an enormous subsidy. Growers claim that if a case is not supplied to them for Rs 6 or Rs 7 the cost of packing becomes prohibitive and as a result soft wood is given at throwaway prices to the saw mills. The subsidy for each packing case is approximately Rs 6, and amounts to Rs 16.8 crore for the 2.8 crore boxes currently used.

Two alternatives suggested to wood are corrugated cardboard boxes and boxes made from pine needles. Cardboard boxes reduce the dependence on wood by a substantial 50 per cent to 60 per cent and are lighter, carry more fruit and can be recycled. But they cost much more than wooden boxes. The manufacturers explain that this is because of the high excise duty on kraft paper. But, so far the Finance Ministry which in the past has given such special exemptions, has not agreed to a proposal to abolish the duty. The resistance came from vested interests: the saw mill owners who stand to lose their captive markets if a substitute is adopted; the prosperous apple growers who enjoy the benefits of cheap subsidised wood; and the forest department which earns revenue from the sale of the wood.

Tobacco is another insidious destroyer of forests. Treating or flue curing of tobacco is a process which involves slow drying of the green leaves by burning wood in a furnace. Thus tobacco is a crop that is smoked twice over—with a heavy price to pay. According to the World Health Organisation, in the developing world, for every 300 cigarettes made, one tree is burnt. Twelve per cent of the trees cut every year the world over are used for tobacco curing. In other words, to produce 2.5 million tonnes of flue-cured tobacco each year the earth's surface is stripped off an equivalent of 1.2 million hectares of forest.

With an annual average of 2 million tonnes, India is the third largest producer of flue-cured tobacco in the world, next only to the United States and China. In one year, 1982-83, the area under flue-cured or virginia tobacco increased 32.7 per cent to occupy 203,000 hectares of land. Tobacco earns Rs 2 crore a day in excise and ranks only after petroleum and petroleum products. Export earnings from flue-cured tobacco in 1980-81 were Rs 115.80 crore.

**Crates use one-fifth of the wood felled in Himachal. (S.Acharya)**

The only study on the firewood consumption of this burgeoning industry is by Praful Bidwai of 'The Times of India', on the consequences of tobacco production in Andhra Pradesh, the principal virginia tobacco growing state. It has 69,000 hectares under virginia tobacco, and produces 40 per cent of India's tobacco. Each year the crop devours anything between 85,000 hectares and 150,000 hectares of forest in a state where effective forest cover is only about 20 lakh hectares to 25 lakh hectares as against the grossly inflated official figure of 61 lakh hectares.

As most of the trees illegally cut are not replaced through afforestation, the effective rate of depletion of forests is about 3 per cent to 6 per cent a year. Official afforestation programmes are hopelessly behind schedule: less than one-fourth of the gross rate of denudation on account of virginia tobacco. At this rate, in another 15 years, there will be no forests left in Andhra Pradesh.

The fuel needs for curing tobacco represent between one-quarter and one-third of the farmer's total expenditure. As the forest department is unable to supply an adequate or assured quantity of wood there has emerged an organised trade in illicit wood, transported all the way from Orissa and Madhya Pradesh, accounting for one-third the wood supplied to the industry.

Gujarat has 41,000 hectares under flue-cured tobacco and accounts for 36 per cent of the total production. In Karnataka, the acreage is rapidly increasing. There is, however, no data about the extent of damage caused by tobacco in these states. Details from Andhra Pradesh can only help us gauge the magnitude of the problem.

Bidwai also states that according to scientists of the Central Tobacco Research Institute (CTRI) this widespread destruction could be mitigated to a large extent if not wholly avoided, by restricting the output of virginia fire-cured tobacco while encouraging the growth of air-cured varieties, using substitutes like coal and briquettes of agricultural waste instead of firewood and improving the design and operation of curing barns to save fuel.

So far none of these methods has been tried out with any degree of seriousness. Instead over the last 55 years the output of virginia fire-cured tobacco has actually increased while the output of air-cured tobacco — which is simple hung in the open to dry — has shrunk by about 35 per cent. The CTRI barn, which effects a net saving of 30 per cent to 40 per cent, has not even been commercially developed. Banning smoking would, in fact ,be the best solution.

## Alternatives

With natural resources in other parts of the country being squandered away a region like Bastar is an oasis and ought to be maintained as a renewable reservoir. But a completely hands-off approach is unrealistic. If a development programme aimed at meeting basic material needs is adopted, the environment can also be saved. The basic needs would include food, shelter, clothing, energy and clean water. A jobs programme could take into account forestry skills of the tribals.

The Hitgrahi scheme is the first step towards such a programme. However, at its current level — 60 families a year — it smacks of tokenism. The scheme should be redesigned to fulfil the objective of restoring the 400,000 hectares of forest land that have been lost in Bastar. The B.K. Roy Burman Committee's report states that if forests are to be regenerated, "a piece of land about 1.5 hectares or so, can make a family more or less economically independent". By leasing 2 hectares per family, 200,000 families — almost the present tribal population of Bastar — can benefit.

As for the cost of such a programme, a very rough figure can be calculated by assuming that each family receives Rs 250 per month, as in Gujarat, for five years. After five years the sale of produce should provide adequate compensation. If the programme covers 10,000 families in the year and adds another 10,000 in each successive year, the scheme would cost about 35 crore over five years. In 20 years the entire area to be redeemed would be covered.

Can Bastar afford this? Yes. Bastar generates an annual revenue of about Rs 47 crore and only Rs. 5 crore are spent here. It is interesting to note that the perspective plan prepared by the NCAER proposed a public investment of Rs 335 crore on specific projects over a period, 1979-1989. It also proposed an additional indirect outlay of Rs 265 crore over the same period. The trouble with the NCAER plan is that the basic model of development is industrialisation.

In addition to regenerating forests, facilities like clean drinking water and health care, preventive measures rather than curative,will also have to be provided. Until the target of regenerated forests is met, the present pattern of exploitation should not be extended. After that, the tribals will most likely be better organised to design and control, their own future.

### Fell Figures

There is half a hectare of forest for every person in Himachal Pradesh. According to the 1980-81 official statistics, about 38 per cent of the state is under forests. However, unofficial estimates put the forest cover at a bare 18 per cent.

A recent study of three selected forest areas—Chopal in Simla district, Chamba in Chamba district and Sundernagar in Mandi district indicates the deforestation problem in the state. Conducted by the Society for Participatory Research in Asia (PRIA), the study concludes that in Chopal, Chamba and Sundernagar the forest cover is half or less than half of what existed 10 years ago.

Most of the deforestation occurred in different periods in the three areas: after 1970 in Chamba and Sundernagar and after 1977 in Chopal. Chamba is the most accessible area, by roads from Punjab. Sundernagar is the site for the Beas-Sutlej Link Development Project and is also the lowest in altitude. On the other hand, access to Chopal, about 12,000 feet above sea level, is not easy, explaining the fact that Chopal faced deforestation comparatively recently.

Government officials blamed the forest dwellers for the devastation, listing grazing, firewood collection, natural fires, calamities and timber distribution (TD) rights of forest dwellers as major causes. It was suggested that 5 lakh cubic metres of timber was distributed free under TD rights and 3.5 lakh cubic metres at throwaway prices. It was maintained that forest dwellers were abusing TD rights and cut five or six trees for each tree legally sanctioned.

Forest dwellers, however, alleged that corruption in the forest department was the major cause of illegal felling. Officials, mostly at the lower levels, were said to have asked for at least two trees for themselves for each TD right tree sanctioned. Hence the forest dwellers were forced to cut at least three trees. Many of them argued that if they cut an extra fourth tree for themselves, it was because they had been taught illegal felling by officials.

People in Chopal believe that about 22 per cent of trees felled by forest dwellers, are mainly for fuel and fodder. In Chamba and Sundernagar the figure is 18 per cent. This clearly shows that, as far as the belief of the local people goes, about 80 per cent of the deforestation is caused primarily by commercial/industrial interests.

Out of 0.56 million cubic metres of timber felled in 1980–81, 85 per cent was used for commercial purposes. About one-fifth of it went for making apple–packing cases.

The forest administration has launched several development programmes: commercial forestry, production forestry, rehabilitation of degraded forests, mixed plantation in panchayats, farm forestry and rural fuel plantation schemes.. However, only 8 per cent of revenue and less than one third of a total of about 11,000 hectares were utilised for these non-commercial development efforts in 1980–81.

An important aspect of forest administration is protection. During 1980–81, the state forest administration reported 33,064 offences, up from 30,875 in the previous year. More than 50,000 cases were pending as only 19,000 cases were cleared during 1980–81. A majority of the offences concern unauthorised felling and grazing. While some forest contractors may be netted in the former, the latter are certain to include only poor forest dwellers.

Forest policy and government strategy seem to be based on the idea that forests must be protected from forest dwellers. The draft 1980 Indian Forest Bill has increased the list of offences to include gathering of forest produce and also mentions grass, flowers, leaves and branches, which were being collected by forest dwellers unrestricted until now. The punishment has also been made more stringent: three years imprisonment, or fine up to Rs 5,000, or both.

Curiously, most forest dwellers still see a major role for the government in forest protection. But they know almost nothing of forest policy and rules. The Chamba people were aware of the implications of deforestation and ready to do something about it. They had set up village level tree–protection committees to organise the fight.

Voluntary organisations and activist groups have organised meetings and workshops to build opinion against the harmful provisions of the bill and work for a more people–oriented forest policy. The PRIA study was part of this exercise. It reported that Himachal Pradesh was one of the most backward states in terms of people's movements. However, as a result of PRIA'S efforts, many field workers and educators, persuaded to act as local investigators, have awakened to the danger in their areas and a few are mobilising for action to save the trees before it is too late.

## What's In a Name?

'Chipko' by any other name would be as effective. In Karnataka, it is 'Appiko'—which means to hug—and it began in late 1983. "Appiko has essentially given articulation to the people's anger, and their feeling of frustration. Not knowing how to protect their trees the idea of hugging the trees gave them hope," says Keshu, a farmer and member of the Yuvak Mandali which is spearheading this movement. The people have two basic complaints: commercial felling by contractors damages a large number of other trees and the teak and eucalyptus monoculture plantations replacing natural forests.

The first Appiko was sparked off on September 8, 1983 by the forest department's felling of trees in Salkani forest in Sirsi district. One hundred and sixty men, women and children hugged the trees, forced the woodcutters to leave, and kept vigil in the forest for the next six weeks. The forest range officer paid them a visit and assured them that "only 590 trees were to be cut under scientific management and in accordance with the working plan of the district". But the people were still sceptical and another meeting was scheduled with the forest department and a group of scientists. The Yuvak Mandali insisted on an inspection of the forests.

The visiting scientist, Professor Madhav Gadgil of the Indian Institute of Science, Bangalore concluded in his report: "We agree that both the contentions of the Yuvak Mandali, namely, excessive damage in the course of felling and excessive concentration of trees marked for felling were in fact true." Under scientific management, an average of five trees per acre are marked for felling but in Salkani 11 trees per acre were marked and on an average another five trees per acre damaged. With the felling discontinued, the people saved about 12,000 trees. Yuvak Mandali members cite other examples of damage during officially-sponsored felling. In Kindal forests of Siddapur taluk, 547 trees were damaged while 51 trees were felled.

Within months, the movement had spread to adjoining districts. In Kalase forests where trees were to be cut down by match manufacturer Wimco, Appiko activists not only hugged the trees but performed a puja to appeal to the religious sentiments of the people. In Bengaon, when villagers began their movement, the forest department reacted in anger. A letter from a deputy conservator of forests at Sirsi to local forest contractors said: "In case you find an obstruction from members of the public under the garb of 'Appiko' movement you may seek police assistance for smooth work." Finally the state forest minister came to the area, walked through the forest along with local people and halted the operation.

Pandurang Hegde is one of the Appiko activists. He had earlier been associated with Sundarlal Bahuguna and brought his experience of forests and forest departments to Karnataka. As do most of his colleagues, he feels that the Karnataka forest department does not work according to working plans and turns a blind eye to the contractors who illegally remove truckloads of wood. "They have forests on paper, not in the fields," says Hegde. He has a point. Twelve years after the setting up of the West Coast Paper Mill, bamboo has been wiped out from the Uttar Kanara area. The forest department has also clear felled natural forests to plant commercial species like eucalyptus and teak, often with poor growth rates.

Uttar Kanara district has a long history of forest movements, beginning in 1831 with a Jungle Satyagraha against the reservation of forests policy of the British. They were granted rights which continue to this day: the Kannara Concession grants a farmer eight acres of forest land for every acre of farm land, to be utilised as a manure resources.

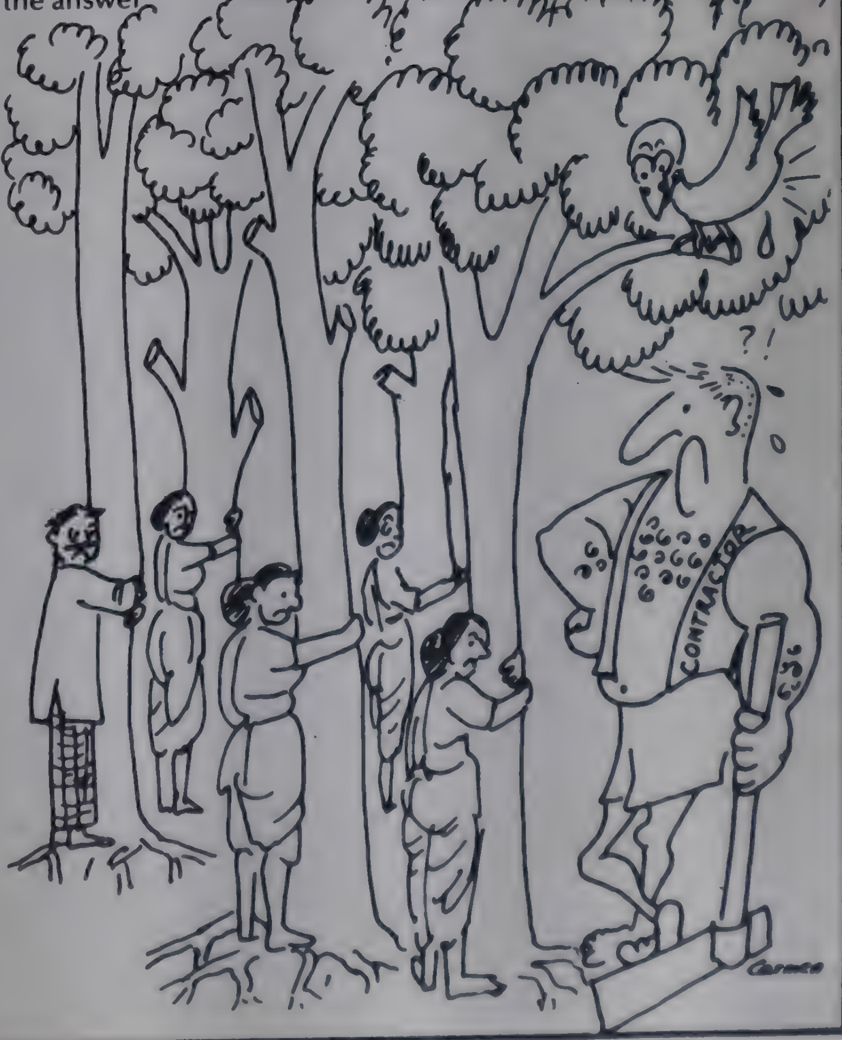
Villagers use the forests for fuel, fodder and, most importantly, for manure. Plantations of arecanut, pepper, cardamom and bananas thrive in moist climate with heavy green manuring. The farmers are thus heavily dependent on the neighbouring forests for leaves. There is also the fear that once the reserve forests are degraded, the forest department will turn to the forests given to the farmers.

The effects of indiscriminate felling first began to be felt in 1960. "Lately, the effects have increased dramatically," says an old farmer. "Broad-leaved trees which protected the soil from the direct onslaught of rain have been removed, the soil washed away, and bare laterite soil left behind. Now nothing grows but a weed called eupatorium." Farmers also complain that rivers and rivulets dry up quicker, and that rainfall is becoming erratic. Diseases and insects earlier unknown are now attacking the crops, because of which arecanut and pepper have suffered heavily.

The forest department, for its part, is unsympathetic. State Chief Conservator of Forests, Shyam Sunder says: "It is indiscriminate removal of wood (firewood) from forests which causes the havoc." The department is also trying to play up firewood shortage in Sirsi town and other urban centres of the state. Shyam Sunder is on record as having said: "A day might come when the urban people will invade the forests for getting firewood." Even eminent environmentalists such as Gadgil would like to see Appiko volunteers to appreciate the measures taken by the forest department and involve themselves in afforestation efforts.

Appiko volunteers respond by saying that while they recognise the fuelwood needs of the urban poor, they doubt if the timber removed by the forest department actually gets to the market. They do not want a total ban on felling, only certain rules and restrictions, for instance, local people should be consulted when trees are marked for felling and trees within 100 metre of a water source and on a slope of 30 degrees or above should not be felled.

Appiko's aim, says Keshu, is to utilise the people's energy to protect and plant trees and to teach the people to minimise the use of forest resources. In this context, questioning the Western model of growth governing national policies, Hegde criticises the allocation of large chunks of forest land for industrial raw material. The West Coast Paper Mill employs 10,000 people, the plywood factory 800 people and, thus, to provide less than 11,000 jobs, the daily needs of a million people are threatened. "Is this development?" he asks. That is a question to which few people in government are willing to give the answer.



## The Government Viewpoint

### The Forest Policy: Questions Unanswered

Following the nationwide uproar in 1982 against the Forest Bill, amending the Forest Act of 1927, the government decided to first prepare a forest policy document. The proposed forest bill was strongly opposed by voluntary organisations, because it gave excessive authority to forest officials to control people entering and using forests, which it was argued, would seldom be used against timber smugglers and other powerful people but more against the poor who need forest produce for survival.

The new forest policy document was prepared by the end of 1983 and sent to the cabinet for its consideration with the approval of the union minister of agriculture. The document has never been made public — although it is available for scrutiny — and nothing is known about the cabinet's position on it or its current status. However, a first reading will show that the document incorporates nothing more than cosmetic changes to the 1952 forest policy.

The trouble with the new document is that it emphasises everything. At one point it states: "...the time has come for initiating a new and pragmatic National Forest Policy. Such a policy should provide for protection, conservation and development of forest and tree-land resources in the interest of survival and growth of the entire agrarian, tribal and industrial economy." At another, it says: "The basic direction of policy ... should ensure primarily the preservation of the environment, and only thereafter derivation of economic benefits ..." There is admittedly greater stress on the ecological role of forests. But behind the verbiage there is no clear guideline for priorities in the case of conflicts over use.

There is no attempt to reflect the expected pressure on forests with industrial and population growth, and consumption-oriented lifestyles. Forests would seem to have nothing to do with industry, agriculture and society. The policy should have clearly stated whether the forests of India in, say, 2010 AD could meet the country's wood needs, if current trends in afforestation and deforestation and wood demand were to continue. If not, then how the pressure on forests should be reduced. But the document does not mention short-term policy measures to get India's forests out of their current critical situation, or long-term measures to regenerate forests and sustainably manage a vastly increased forest wealth. In fact, how the country's vast, degraded forest areas are to be afforested is not mentioned at all, and neither are the institutional mechanisms and methods which ought to be adopted. Presumably the authors believe that the same forest departments which have presided over the destruction of forests will now also be able to preside over their regeneration.

Professor Madhav Gadgil, who had helped the Department of Environment (DOEn) formulate its own position on the forest policy, and social scientist Ramachandra Guha are blunt in their criticism: "It would not be unfair to state that the overriding concern of the present draft seems to be the retention of the present monopoly enjoyed by the forest department over forest protection and production ... The department exhibits a true instinct of territorial greed in refusing to let go of any land presently under possession even where this is an environmental necessity ... the present policy emulates its colonial predecessor in asserting an absolute state monopoly over forest land and in arbitrarily listing conflicting aims."

Forest departments keep saying that people's animals are responsible for suppressing regeneration. Is the new policy to keep forests open to the people or to shut them out? The policy does say clearly that forest dwellers' rights and concessions should be reviewed and the vigilance and enforcement machinery strengthened, but will there be a policy to find the people alternative sources of food, fuel, fodder, building materials and raw materials for crafts or will the people be left to fend for themselves? The report talks about illicit and indiscriminate fellings "in order to meet demands of right holders" living in the neighbourhood of forests, but makes no mention of timber smuggling by chief ministers and the like.

A major distinction between the DOEn recommendations and the Ministry of Agriculture document is on the management of natural forests. The DOEn document states categorically that the remaining forests should not be logged at all, even if pulp has to be imported for paper and rayon mills. It also says that there should be no further clearfelling of natural forests and replacement with exotic monocultures, as recommended by the National Commission on Agriculture: new plantations will best be planted on wastelands. By remaining silent on this point, the draft policy clearly intends to allow felling in natural forests where it is believed to be ecologically feasible. Gadgil and Guha argue that such a provision is always open to misuse. Ominously, the document states that monoculture plantations must be interspersed with blocks of natural forests, which indicates that clearfelling of natural forests could be allowed.

Even on the conservation issue, the document only states that "conservation of wildlife is one of the main objectives of forest policy", which does not indicate an awareness of the narrowness with which "wildlife" has been understood in the past. The emphasis in conservation has to shift from spectacular beasts like tigers to preservation of natural habitats and 'gene pools'.

The document is contradictory and confused in places. The 1952 policy had advocated the classification of forests by function. "Protection Forests" to be preserved or created for ecological and environmental reasons, "National Forests" for catering to the needs of defence, communications and industry and "Village Forests" to provide for the needs of villagers. This policy guideline was not followed in practice because foresters argued that forests have multiple uses and could not be divided into watertight compartments. The new policy states that "It is not a practical proposition to build a forest management programme around one single objective, for forests perform multiple functions ..."

A note prepared in the Planning Commission on the draft policy strongly disagrees with this contention and argues that there is even today an urgent need for balanced and complementary landuse, as stated in the 1952 policy. The note says: "No doubt forests have multiple uses and they should be managed to realise multiple objectives. Without clearcut zoning, there is always a tendency to give priority to wood production, adversely affecting watershed values, conservation of flora and fauna, wilderness values, etc."

Furthermore, Gadgil and Guha point out that it is inappropriate to distinguish between the "conservation-oriented" and "economic-oriented" needs of the country. They argue: "The two cannot be viewed separately. A balanced land use policy must recognise this interdependence in all respects, ranging from the choice of the tree species to be planted to the interrelationship between different plant and animal species in an ecosystem, with a view to aiding environmentally sound human intervention." But this calls for knowledge of and research on Indian ecological conditions, which is something that foresters lack. Gadgil and Guha point out: "While there are 25,000 agricultural scientists in the country, only a few hundred researchers are active in forestry science. The Forest Research Institute in Dehra Dun, which holds a near monopoly of such research is controlled by forest managers who come on short-term assignments and are consequently unable to do justice to the task. The construction of a full-time forestry research service is, therefore, imperative if the research base is to be strengthened. But yet again none of these recommendations of DOEn have been accepted."

Equally disturbing is the support that the new policy gives to commercial 'social forestry' programmes despite criticism of them nationwide. The document categorically states: "The demand for primary produce from forests has been outpacing the supply, one solution is to cover the gap through social forestry programmes in the private holdings ... such programmes will not only meet the personal requirements but may eventually develop into commercial propositions also."

**Land alienation and deforestation have led to many tribal revolts. Over 75,000 Santhal tribals at an angry meeting with bows and arrows. (Himmat)**

Though the document does not call for a ban on shifting cultivation a "motivational approach through introduction of alternative programmes" has been recommended — its language is harsh. It describes shifting cultivation as an "inefficient method of agriculture" which "militates against sound land management policy", and which ought to be regulated, contained and eventually replaced.

Probably the worst is the scientific basis of the new policy. As in the 1952 policy, it is stated that at least one-third of the total area should be under forest. In the mountainous regions, forests should cover not less than 60 per cent. But what is the logic behind these figures? Are they based on any detailed analysis of India's topography, extent of slopes and different types of ecoclimatic conditions and soil resources or on people's and industrial needs? Sharad Kulkarni of the Centre for Tribal Conscientisation points out that it could have been clearly stated, for instance, after an analysis of people's fuel and fodder needs that a minimum of say, 5 per cent of the land area in every district should be under tree cover. Over a quarter of the districts in India have less than 5 per cent of their land area under forests.

The Planning Commission note even asks what a forest is. "If the definition of forest is broadened to include area under tree cover, in Kerala more than 50 per cent of the geographical area would be under forest," it says. This vagueness in definition could allegedly become an argument to replace natural forests with plantations. The note concludes: "It is important that the policy clearly indicates the area that should be under natural cover to fulfil the objectives of conservation of species diversity, watershed protection, recreational values, etc."

In the ultimate analysis, says Kulkarni, these policy statements, however pious don't matter much: what matters is the legislation that is developed on the basis of this policy. "It should be remembered," he warns, "that an attempt to introduce the same bill under the shelter of a pious statement will create the same opposition and meet the same fate."

## Forest Forum

The government is markedly indifferent to the report of a Home Ministry-appointed committee which stands strongly in favour of tribal rights in forests. The committee has rejected the notion that India's 43 million tribals are responsible for the forests' degradation and recommends that the new forest policy under preparation should be sensitive to tribal needs and concerns.

The committee, chaired by well-known tribal anthropologist B.K. Roy Burman, and which included several senior forest officials, had submitted its report in October 1983 but no decision has yet been taken on its recommendations. Forest officials in the Agriculture Ministry are reportedly unhappy with the document. The Centre is unlikely to reject the report in an election year and will probably sit on it until the end of the year.

In 1976, the prestigious National Commission on Agriculture said that the tribals' "rights and privileges have brought destruction to the forests and so it is necessary to reverse the process." The Roy Burman committee, on the other hand, points out that the tribals' forest rights are tied up with their livelihood. Forests not only provide them with food, fodder and fuel, minor forest produce is a major source of income. The report cites a study conducted by the Administrative Staff College, Hyderabad, which shows that during drought and adverse conditions the tribals live only on edible forest produce. Sales of minor forest produce accounts for as much as 30 per cent of the total earnings of the tribal people in some areas.

According to the report, modern forestry operations have added to the destitution of the tribals. "By and large forestry operations have been regarded as revenue earners for the state and private sectors," says the report. "Tribal economy has figured little among the parameters of a forest policy and at best, tribals continue to be wage earners. Like other developmental activities, mere growth of more trees or generation of more income is not necessarily sufficient. It cannot 'ipso facto' lead to distributive justice. Benefits should flow to tribal people by imaginative forestry programmes and conservation and re-organisation of their traditional skills."

The committee argues that a renewable resource like forests cannot be managed by policing it but by involving the people. "There is lot to be said for the view that forests should be managed primarily by the forest dwellers and backed by technical guidance of the forest department," says the report. The committee pleads that any new forest policy should recognise the positive role of the local people. It cites successful experiences in community management of forests in some northeastern states and in popular movements like Chipko.

The report emphasises the immense potential of forestry in reducing poverty and generating rural employment. The sixth plan sees the forestry sector as providing employment (6.2 million person-years) as compared to agriculture (72.18 million person-years). But the committee says that "since the forest area is about half of the agricultural area in the country, free of constraints the forestry sector should be able to generate employment for about 20 million person-years."

The report suggests that while management of reserve forests should be entrusted to state forest departments, panchayats, village communities and individuals should be involved in afforestation of protected and other forest lands. Forest based industry should be a joint venture of three parties: the concerned corporation, the entrepreneur and the tribals. The tribals' share in the forest produce would ensure their participation. Tribals should be encouraged to grow raw materials for the industry. For this, the corporate body should provide tribals with extension services, and incentives like assured purchase of raw materials grown by them. Financial institutions could give loans for quick growing species.

The social forestry programme could be tackled similarly with tribal initiatives. Efforts should also be intensified to market minor forest produce so that maximum benefits accrue to the tribal population. With respect to legal rights, the committee says that "the traditional rights, concessions and privileges of the tribals in respect of forest produce, grazing and hunting should not be abridged. Further they should be appropriately incorporated in the record of rights."

The committee recognises the difficulties in implementing its suggestions but it stands convinced that these suggestions alone can solve the immense problem of afforestation. Unfortunately, with this crucial report gathering dust, it is obvious that the government is not ready for the 'democratisation' of forests.

## Ban the People

Lurking within the corridors of Union Ministry of Agriculture is a report that was completed in early 1984 but has yet to see the public light. So distressing and anti-poor are the recommendations of this all-too important report on rights and concessions in forest areas that even the government has been hesitant in releasing it.

This report was submitted to the ministry by Dr M.S. Chaudhary, former chief secretary of Madhya Pradesh, and it recommends the curtailing of the rights of the rural people in literally every area vital for their survival. And this the report does in "the national interest".

Who constitutes the nation, the reader may well guess.

Forest rights and concessions have been codified by all Indian states and vary enormously. In West Bengal, for instance, no grazing is allowed in reserved and protected forests. But in Andhra Pradesh, free grazing is allowed in all forests except regeneration areas.

The report uniformly blames the poor for the destruction of forests. It indulges in financial hyperbole by putting a monetary value to the forest products collected by poor people and then considers this to be a loss to the exchequer. Says the report: "If the cost of invisible subsidies and concessions is computed, the resulting figure would be astronomical. Calculations made by the M.P. Forest Department reveal that the value of forest produce used annually by the concessionists is in the neighbourhoold of Rs 70 crore . Unfortunately, the value of benefits remains unknown to the beneficiaries and the governments continue to remain blissfully unaware of this large revenue foregone for want of its being reflected in their budgets." The committee obviously thinks that it is the government which owns the land and the people only live by its sufferance.

The committee, of course, makes no mention of the concessions given to the forest based industry even though its terms of reference does not prevent it from including these. In fact, in all committees set up by the Union government to assist it in the formulation of a national forest policy, the emphasis is on the impact of rural people's activities in forests and steps needed to 'rationalise' or 'restrict' their use of forest resources.

The committee's foremost recommendation does just that. It says that "exercise of rights and concessions should be restricted only to those ... people who are residing a maximum distance of 8 km from the existing forests." The scientific basis of this 8 km distance is not explained. Moreover, this arbitrary line of demarcation damns all those people living away from forests but are still heavily dependent on them.

Implicit in this recommendation is a call to ban nomads some 6 per cent of India's massive population, who depend heavily on forests. Thus, it recommends the need to "rehabilitate the Gujars and Bakarwals in the Himalayas as they are a positive threat to the forests and suggests a search for alternative occupations. But the committee fails to mention that successful efforts to rehabilitate nomadic people or shifting cultivators are few, as the Roy Burman committee report—another report in this series—explains, and in effect such recommendations only lead to laws against the poor.

The committee argues that forest rights and concessions have been steadily liberalised by governments because of political pressures from people, who in turn have been influenced by middlemen and contractors. The report states: "In the euphoria of Independence, expectations of people to get more and more from forest land increased. With the approach of every election, these pressures culminated in arbitrary and irrational use of forest resurces and forest land through liberalisation of concessions." The committee, obviously, believes that the British ruled better.

The committee's overriding view is that concessions are today far in excess of what a family needs. It suggests a careful scrutiny of the beneficaries and their needs, and a periodic review of the concessions given. It also contends that forest concessions are today far in excess of the carrying capacity of the forests. They have thus "brought forest management, in very large parts of the country to a stand-still." Forests it says, have a carrying capacity of just over ten million cattle but more than 40 million cattle graze in forests. The committee argues that state governments have also relaxed concessions given to the people by permitting sale and resale of firewood collected through headloads, and this is causing immense harm to forests. The committee, therefore, categorically states that "it would be necessary to restrict the entry of headloaders in forests" ....... the sale of headloads in urban areas should be completely banned ... As railways and used as a major means of transporting headloads, it would be necessary for the railway ministry to ensure that no fuelwood is transported by passenger trains, as it happens today."

The report's class bias is not hidden. It takes note of the plight of "urban unemployed persons and even educated people who are currently engaged in the headload business" and who would suffer from the recommended ban. It states: "it would be necessary, on humane grounds, to provide them some employment." But about rural people, especially the landless who often find headloading the only source of income available to them, there is no recommendation. Even for urban people, what should come first? The ban or alternate employment? Is it not irresponsible to suggest a ban when there is no guarantee that the government will provide alternate employment?

With respect to timber, the report says that "the demand from forests for agricultural purposes (of all things) is indeed colossal." After all, as it points out, the 500-odd million rural people of India possess 100 million ploughs, 95 million other agricultural implements, 50 million yokes and 14 million bullock carts! Beneficiaries of concessions, it recommends, should not be allowed to enter forests. The forest departments should open depots outside forests. The committee also recommends that concessional rates should "maintain a positive relationship" to market prices but, of course, makes no mention that these concessional prices are often higher than the prices at which governments hand out millions of tonnes of timber and bamboo to organised industrial lobbies.

To stop people using forest resources, the ridiculous recommendation has been made that wooden implements should be replaced by steel, and monetary assistance given to transport cement to the mountains, so people stop making wooden houses. The report does not calculate the energy and environmental costs of steel and cement production and the subsidies that would be required to get these high-cost and high-energy materials to the poor.

The report is suggesting a transformation in the use of forests but without any understanding of the socio-economic context in which forest resources are used in India, of any quantification of people's present and future needs, and of energy and environmental management issues. No report makes foresters' biases more evident than this one.

Raghu Rai/India Today

# DAMS

*Large dams are today India's most controversial environmental issue. Silent Valley has already been given up. Groups are protesting against another half a dozen.*

*The key issue is not nature but people. Energy and water planners are stressing hydro-power and canal irrigation but have made no study of how many people will be displaced.*

*Government officials argue that "someone has to suffer for progress". Usually these "someones" are tribals, the poorest and the most powerless.*

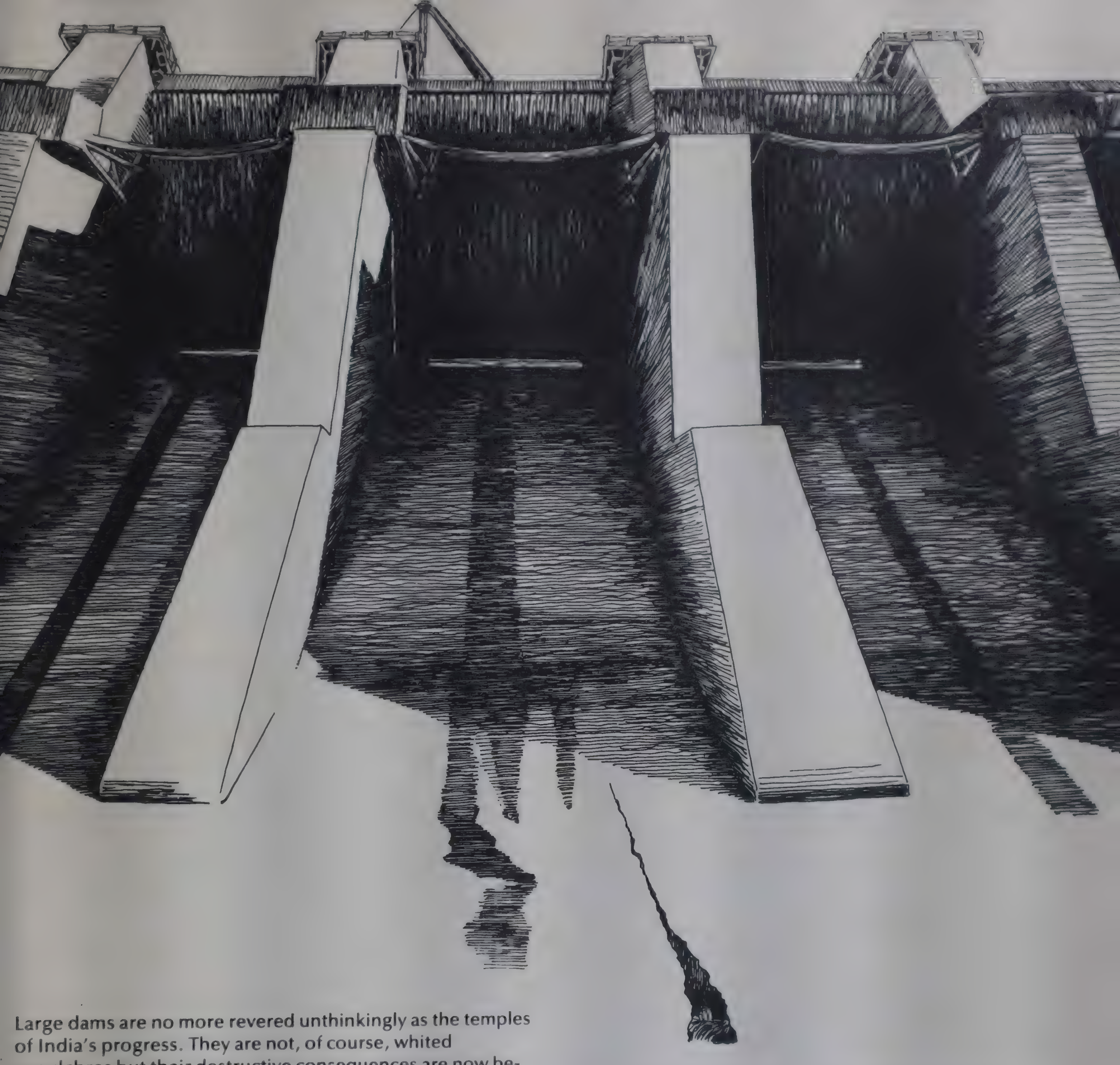
*The colossal Narmada Basin Development Programme, which will involve the building of 329 large dams, may end up costing Rs 25,000 crore. It will also displace a million people.*

*Experience shows that people, for the moment, are prepared to move but they want new land for old. Except in Maharashtra, this principle is not accepted by any state government.*

*The cost of forests lost is also high. Large dams have drowned half a million hectares of forest—about a tenth of the area that has benefited from canal irrigation.*

*With 176 major and 447 medium irrigation projects, under construction, most behind schedule, some experts argue: "No new projects now; consolidate and learn to get good crops from what we already have."*

*Small earthen dams for water harvesting are both ecologically sound and economically profitable. Three small reservoirs have transformed the economy of a village near Chandigarh. There is no soil erosion, no deforestation, no desertification, and no one has been displaced. The lesson: water conservation, yes; big dams, no.*



Large dams are no more revered unthinkingly as the temples of India's progress. They are not, of course, whited sepulchres but their destructive consequences are now being increasingly recognised. Even so, bigger and bigger investments are being made in them. All major rivers today are dammed or in the process of being so. Only a fraction of the country's hydropower potential has been realised. This indicates that in the next two or three decades, dam construction is going to be a major development activity.

In the light of recent experience, questions are now being raised about the viability of large dams which have often proved to be ecological disasters. Can there be ecologically sound and economically viable engineering alternatives to large dams? If dams are inevitable for a large country faced with the task of feeding its growing millions and for meeting its energy requirements, can the destruction they cause be minimised and adequately managed?

Over the last few years several citizen's groups have come to protest against dams and hydroelectric projects. The list is long: Silent Valley and Munnar in Kerala, Bedthi in Karnataka, Tehri and Vishnuprayag in the UP Himalayas, Kôel-Karo in Bihar, Lalpur in Gujarat, and Bhopalpatnam and Inchampalli on the Madhya Pradesh, Maharashtra and Andhra Pradesh borders. The number of dams where resentment festers but no organised action has been taken is even longer.

Debates on the ecological impact of dams have generally remained confined to environmentalists. The protest against the Silent Valley hydel project in Kerala was started by the Kerala Sastra Sahitya Parishat (KSSP), a grassroots organisation involved in mobilising people in a variety of ways, including non-formal science education. The importance of Silent Valley as a rich biosphere and one of the few surviving rain forests in the country attracted widespread attention throughout the country and even abroad. Backed by environmentalists in metropolitan cities and international environmental organisations, the KSSP forced the government to appoint a high powered committee headed by Professor M.G.K. Menon, currently member of the Planning Commission. Though the committee could not give clear-cut directives, it tilted in favour of the conservationists and the project was dropped at the instance of Mrs Indira Gandhi despite the state government's support for it.

**Anti-dam campaigns**

Meanwhile, Chipko movement leader Chandi Prasad Bhatt has started a campaign against the Vishnuprayag hydroelectric project because of the dangers it poses to the unique ecosystem of the Valley of Flowers and the general geological havoc it could create. Bhatt, as he has shown with the Chipko movement, is capable of mobilising strong support among the local population though a section of the workers who have found jobs on the project oppose the campaign.

Another instance of intervention at the highest levels resulting in the shelving of a large dam is Lalpur in Gujarat. Gandhian social worker Harivallabh Parikh, an ardent supporter of Mrs Gandhi and a close associate of Jinabhai Darji, an influential Congress(I) leader in the state, runs an ashram at Rangpur, which would have been submerged if the project had materialised. He raised two issues—destruction of forests and displacement of tribals—in a letter to Mrs Gandhi. A committee is preparing an alternative plan.

These very issues are cited by Baba Amte, while mobilising protest rallies against the Bhopalpatnam and Inchampalli dams. He is also questioning the very raison d'etre of big dams by asking: whose development do these dams represent? Amte's strategy is to mobilise people through mass rallies and public opinion by getting in touch with environmentalists, political leaders, planners, journalists and even the Prime Minister herself through meetings, discussions and personal letters.

The protest against the Tehri dam in Garhwal is another, where along with rehabilitation, environmental issues relating to large dams have also been highlighted. The Bandh Virodhi Sangharsh Samiti led by advocate V.D. Saklani has underlined the threat to the ecological balance of this sensitive mountain region through rallies, seminars and even wall writing. The movement has gained momentum and local support because of the strident protests by citizens of Tehri town, which will be submerged by the hydro project.

**Organised tribals**

Tribal populations who are affected by a large dam are fully aware that they will lose their trees, land and houses. The Munda tribals of Chhota Nagpur, who celebrate their festivals by planting saplings, are today fighting against the massive Koel Karo project. As one tribal from the area, questioned about the compensation he will get, replied: "Can you give back our trees planted by our forefathers?" The tribals of Chhota Nagpur likely to be affected by the Koel Karo project are well organised, with a coordination committee and a representative from each village. Local leaders of various political parties are also part of the organisation, making it probably the strongest popular movement in India against a dam.

The movement has a single demand: comprehensive rehabilitation—social, cultural and economic. The Koel Karo Jana Sangathan is involved in negotiations with the government for getting as much compensation as possible. In Koel Karo, people succeeded in stopping work by their Kam Roko (Stop Work) movement in 1978 and want the authorities to involve the affected people in fixing rehabilitation terms. In mid-1984, the new chief minister of the state had ordered armed police into the area to put down the tribals.

By contrast, in the absence of organised protests or support from any voluntary groups, people's houses were bulldozed for the Srisailam project in Andhra Pradesh and the villagers were hounded out by demolition squads.

As far as rehabilitation is concerned, the movement in the villages affected by the Sardar Sarovar dam on the Narmada is setting an example. The Narmada Tribunal Award spelt out terms for villagers displaced from Madhya Pradesh and Maharashtra and, under pressure from various voluntary groups, the Gujarat government had to agree to similar terms. To ensure that the rehabilitation programme is carried out properly volunteers of the Gujarat Chhatra Yuva Sangharsh Vahini have gone into the villages and are

### Silent Success

After an on-again, off-again status that lasted seven years, the Kerala government finally called off the Silent Valley hydel project in November 1983, in deference to the sentiments of Mrs Gandhi. It however refused to endorse the ambiguous findings of the joint committee headed by Prof M.G.K. Menon, which concluded a few months earlier that year that there were two sides to the dispute but leaned heavily towards the environmentalists.

Balakrishna Pillai, Kerala's electricity minister, has announced that Kerala will press for an alternative scheme—its pound of flesh. This envisages diverting the waters of the Kunthipuzha to a reservoir outside Silent Valley and generating power at Mannarghat, at the base of the Silent Valley range in Palghat district. The ecological consequences of this proposal will have to be studied in detail: even if one-tenth of the 8,900 sq km valley is not submerged, as was initially planned under the Rs 80 crore scheme drawn up by the Kerala State Electricity Board (KSEB) to generate 120 mw, interfering with the normal flow of the river may affect the unique vegetation of the area.

In any case, Kerala has already been able to squeeze sanction for a Rs 1,000 crore 750 mw hydro station at Pooyakutty. However, this is in Idukki district, which already generates three-quarters of the state's power, whereas Silent Valley was supposed to provide for the northern region of Malabar, historically the poorest. Although the Left Democratic Front headed by former chief minister E.K. Nayanar of the CPM, has pledged itself to fighting for the Silent Valley project, this appears more a political exercise designed to embarrass the ruling coalition, which bowed to the Prime Minister's wishes. One indication that the valley will not be dammed is the state government's declaration that it will form part of a national park shortly.

The Silent Valley controversy marks the fiercest environmental debate in the country and is likely to establish a precedent wherever any major development project — particularly a dam — threatens the ecological balance. Only a couple of days after Pillai made his announcement regarding the shelving of the scheme, critics of the massive Narmada Sagar irrigation project in Madhya Pradesh were citing the decision. It has been raised in the case of the Bhopalpatnam-Inchampalli projects on the Indravati and Godavari rivers in central India. All these three schemes do not threaten a fragile ecosystem, as was the case in Silent Valley, but will inundate hectares of forest and cultivated land. What Silent Valley has achieved, therefore, is to lay down a new paradigm: development without destruction.

The drought that Kerala and other southern states faced in 1982-83 has underlined this lesson. While Kerala has been considered a "surplus" state in power generation, it had to impose the biggest power cuts in living memory when the monsoons failed. And this as even power engineers now admit, was because of the widespread denudation of forests in catchment areas of hydel projects in the state. For the first time, the connection between forests and the retention of water has been made painfully clear to the people of Kerala.

both educating and organising the villagers. Researchers from the Centre for Social Studies at Surat have conducted a detailed house-to-house survey in all the villages and presented detailed reports on their needs. At the state level, there are other voluntary groups which have been instrumental in bringing pressure to bear on the government.

**Future issues**

Large dams are generally being constructed in areas which have so far not been touched by 'modern development'. Many people in these areas look at such projects as symbols of hope. They even accept the argument that someone has to pay the cost for the benefits to society, even if they are the ones who have to pay. As things are today, people are not likely to oppose dams en masse. But they are definitely getting ready to agitate for better rehabilitation terms. But also as more and more dams are chosen on environmentally sensitive sites, as in the Himalayas, or in heavily forested areas, protests against dams are likely to grow. Meanwhile, a number of experts have even begun to question the very usefulness of the large surface irrigation systems that dams promised, which means that a thorough analysis of India's current water management plans—and especially of dams—is urgently needed.

In most cases, as in Koel Karo, these groups are fighting mainly for better terms of rehabilitation. But in a few cases, citizen's groups have even begun to demand that a dam or a hydroelectric project not be built at all either because of the numbers of people it would displace, as with Bedthi or with Bhopalpatnam and Inchampalli, or because of the unique ecosystem it would destroy, as in the case of Silent Valley or the Vishnuprayag hydroelectric project. Some of the anti-dam campaigns have even been successful in stopping these massive projects: Silent Valley and Bedthi have already been given up by the Kerala and Karnataka governments respectively. And government committees are investigating the environmental impact of the Lalpur dam, the Vishnuprayag hydroelectric project and the Bhopalpatnam and Inchampalli dams.

## Dams and forests

A large dam inevitably alters the course of nature and, because of the play of complex and largely unknown forces, the ecological consequences are usually much more serious than were bargained for. Silent Valley has been dropped but the government has decided to go ahead with Tehri, Vishnuprayag and many other projects. Also being proposed is the Manibhadra dam in Orissa, in one of the prime forest areas remaining in the country.

The forest cover bears the brunt of dam construction in more than one way. In the Himalayan valleys, contractors who come to clear the forest which is going to be submerged greedily cut trees even in unaffected areas. People who are being displaced from Tehri town in Garhwal to make way for the dam will be rehabilitated on forest land that has been acquired and cleared near Hardwar and Rishikesh. The forest is also being cleared for approach roads, offices, residential quarters and for storage of construction material. With the reduction in forest cover and the entry of people, the pressure on the remaining forest increases. Their need for firewood leads to further denudation. The construction of a dam, therefore, has a multiplier effect.

The 1983-84 annual report of the Department of Environment reveals that the construction of the Idukki dam over the Periyar river in Kerala has hastened the degradation of vegetation and sharply reduced the forest cover. It is estimated that during the period 1951-1976, 0.49 million hectares of forest has been lost due to major river valley projects. This is roughly 10 per cent of the area that came under canal irrigation — 5.5 million hectares.

Despite the increased awareness about the need to protect forest cover, little attention is paid to this factor when a site is selected for a dam, basically because all forests are state property and no one has to be compensated for them. Even in cost-benefit calculations, forest loss is grossly undervalued and the recurring loss in terms of timber and firewood yield per year and social costs of degradation of environment are never taken into account. Undervaluation of standing forest helps in boosting the cost-benefit ratio for obtaining Planning Commission approval and finance from international agencies like the World Bank. Moreover, the contract for clearing the forest is also undervalued, thus leaving a bigger margin to be shared between the contractors and the forest department.

Because of public protest, some provision is now made for reforestation or compensatory afforestation. In Tehri, for instance, Rs 10 crore have been provided for this. With

### The Fight for Munnar

One of the oldest and most beautiful hill-stations in Kerala could find itself under water if the Kerala State Electricity Board (KSEB) has its way. Munnar is a plantation town 150 km from Cochin nestling in the high ranges of Idukki district, surrounded by impeccably maintained tea plantations and exotic gardens spread over 9,900 hectares. The KSEB proposes to build a dam that will submerge the 125-year-old township and its gardens.

With the construction of the dam, 8,000 of Munnar's 21,000 workers will be left jobless. It will also affect 5,000 families as about 3,000 hectares of tea plantations will be submerged. Most of this land belongs to Tata Finlay whose Kannan Devan tea plantation in Munnar is their largest holding in the country.

The KSEB plans to build the Rs 120-crore Munnar dam just below the present Pallivasal power plant, the first hydroelectric project in Kerala built by the British. According to the KSEB, hydroelectric projects have a life of 40 to 50 years and the Pallivasal's time is just about up. With the new dam, which has a capacity of 240 mw, the board hopes not only to replace the previous project but also to augment the power supply in the state.

To push home this point, State Electricity Minister R. Balakrishna Pillai argues that the dam is absolutely essential for the industrialisation of the state. He also said that no more than 2,000 people would be displaced.

The Tamil Nadu government has already sent warnings that thousands of poor Tamils, who form 90 per cent of Munnar's work-force, should not be displaced. The local Marxist MLA, G. Varadan, who is also a Tamil said that the people who were likely to be most affected would be poor Tamils and Harijans.

The people of Munnar are not sitting back idly waiting for help. Apart from a bandh, they have also sent appeals to the Prime Minister and a memorandum to the chief minister. Speaking for the township, Reverend Father Augustine Pinheiro says: "When Munnar is submerged it will displace nearly 5,000 labour families which is a tragedy as vast in magnitude as the proverbial Biblical flood." One of the slogans in Munnar says it more tellingly: "If monkeys can live in Silent Valley, trees can live in Pooyakutty, cannot human beings live in Munnar?".

the best will in the world, it will take at least 10 years to 12 years for forest cover to appear. Compensatory afforestation in catchment areas should, therefore start with the planning of the project, since it will also help in reducing flow of silt into the reservoir.

### The Maharashtra Act

Maharashtra is the only state in India which has a legislation that recognises the right of people displaced by irrigation, power and other public utility projects to get land in the area benefited by the projects. The Maharashtra Resettlement of Project Displaced Persons Act, 1976, was a direct outcome of two decades of sustained agitation by people affected by building of dams.

The act grants displaced people land in the command area of irrigation projects and even provides land for landless in the displaced village. While agriculturists get at least half of the land lost by them, agricultural labourers, artisans and other landless people also get one acre, if they leave along with other displaced persons. Under the act, the government is expected to appoint a resettlement officer, who at the very inception of the project will survey the families to be displaced and identify land available for resettlement in the benefited zone.

Since 1964, the people in the drought-affected western part of Maharashtra have actively protested at least twice every year, against the building of dams under the banner of Maharashtra Dharam Avam Prakalpa Grasth Shetkari Parishad.

The people here are not against the construction of dams, but they oppose the discrimination in the distribution of benefits. The Koyna dam in 1958 displaced thousands. Then came Panshet, Veer, Ujhari, Verasgaon and Kukri dams.

In early '60s, people affected by Panshet and Veer dams repeatedly launched satyagraha to stop construction work and at times more than a thousand people courted arrest. In March 1969, they demonstrated outside the Assembly in Bombay. The affected villagers of Kukri and Verasgaon dams also agitated and interrupted construction work in their areas. In Kolhapur, the survey work was stalled for three days and a morcha of 3,000 farmers walked 27 kilometres to the district collector's office. At Kagal, the affected farmers staged a four day dharna at the project site and 4,000 people made a representation to the revenue minister. At the site of the Kukri dam, thousands of people gheraoed a central minister and prevented him from laying the foundation stone for the dam.

The Panshet dam is a case in point of the long struggle of the affected people. At Panshet, work started in 1958. The dam was to submerge 21 villages with about 1200 landowning households and 200 landless families. No notice of land acquisition was given to the people. Details of the compensation remained only a rumour. The village leaders and local elite took the opportunity to grab all they could in this situation of uncertainty.

At this point Govind Thapera and various other activists intervened. They had earlier been involved with the agitation of the people affected by the Veer dam. They organised village meetings to clarify the issues and expose the authorities. At a meeting attended by 4,000 people, a plan of action was chalked out. They told the people of the experience of the people affected by the Veer dam, where alternative land had been given but in a drought prone area. The movement of the people affected by the Panshet dam gathered momentum. They offered satyagraha, went to jail, and demanded land for land in the area benefited by the dam.

In 1968, their agitation became a focus of the simmering discontent in other parts of the state, and all these movements joined hands to press the state government to meet their demands. Meanwhile, the affected people cooperated with the surveys of the Second Irrigation Commission and influenced it in their favour. Faced with continuous pressure, the government passed the necessary legislation in 1976. But since then the fight goes on for its implementation in a manner that all affected people can benefit.

## Dams and people

It is unfortunate that, despite the massive dams built over three decades, there is no rehabilitation policy worth the name. Rehabilitation becomes much more important and difficult when most of the displaced are tribals. Tribal life and culture is so uniquely interwoven and integrated with the forests that once uprooted, they are totally disoriented.

The main problems regarding rehabilitation have been well evoked by the remarkable studies on the gigantic Sardar Sarovar (Narmada) project in Gujarat conducted by the Centre of Social Studies (CSS) in Surat and the Lokayan study on Srisailam. The issues can be summarised as follows: rehabilitation has always been considered an obstacle in implementing a project and an extra financial burden; the authorities always try and get away with the minimum; no guidelines exist to include even the barest arrangements for rehabilitation in project plans; and facilities provided differ from project to project.

Provision of measures like "land for land" and basic amenities like drinking water, schools, dispensaries and so on were made obligatory in the case of Sardar Sarovar. That had been made possible because of a dispute between the three states—Maharashtra, Madhya Pradesh and Gujarat — which was handed over to a tribunal. The tribunal outlined the rehabilitation arrangement to be carried out by the Gujarat government. As Gujarat was to bear the costs of rehabilitation of the affected villagers of Maharashtra and Madhya Pradesh these two states saw to it that fairly elaborate measures were included in the tribunal's award.

The award was silent about the rehabilitation of the 'oustees' from affected villages in Gujarat. It was only after a tough stand by voluntary agencies that the Gujarat government agreed to similar provisions for its own oustees. When Gujarat got down to implementing these measures, it was reported to be shirking its promises. In any event, the Narmada award has become a precedent for subsequent hydro-projects.

### Meagre compensation

The only legal powers with the government to handle rehabilitation is the Land Acquisition Act, enacted by the British in 1894. Apart from cash compensation, any effort to resettle people is considered charity. Compensation for land and houses is usually grossly inadequate, and none has ever been paid for loss of employment or disruption of livelihood other than from land. Landless labourers, marginal farmers, sharecroppers, tenant cultivators and those who live on collecting and selling forest produce have suffered most. Village artisans whose base is the village also get uprooted. Small farmers who supplement their income by rearing cattle are hit because new settlements never have enough grazing land. Villagers are forced to sell off their cattle at throwaway prices before shifting.

People engaged in non-agricultural activity like fishing are also not entitled to compensation. For example, there are 750 families along a 150-km river stretch downstream of Broach town who make a living out of catching hilsa fish. The construction of Sardar Sarovar will interfere with hilsa migration and 750 families will be rendered unemployed. No one in authority ever pauses to ponder the fate of the people involved in so-called marginal occupations.

To add insult to injury, the meagre rehabilitation measures are implemented half-heartedly. The entire process, beginning with the notices issued to the villagers for acquisition of land to the final settlement, is a story of misery. Poor people are harassed, hounded out of their villages and handicapped for the rest of their lives. The whole operation is conducted in a most unimaginative and bureaucratic manner as the story of oustees from the Srisailam project (SOE '82) demonstrates.

**Nightmarish experience**

The law requires that written notices be issued individually to the villagers for acquisition of their land and houses. The villagers, mostly tribals, are illiterate and ignorant of the legalities and get confused. As the experience of the Koel-Karo project in Bihar shows, panic spreads from much earlier when the project is being planned. Rumours abound about the rate of compensation and resettlement sites.

In the case of Srisailam, the notice specified terms of compensation with a clause that appeals about the rate had to be submitted in writing by a stipulated date. The rate of compensation was very low and depended upon the type of land, house and so on thus leaving a lot of elbow room to the land acquisition officers. Though the law provided for compensation at the market rate according to the latest land deals in the area, the compensation was arbitrarily fixed by the authorities.

It has been the experience everywhere that the rich farmers bribe the officers and manage to get higher compensation and better alternative lands, whereas the poor keep running from pillar to post. Vidut Joshi of the CSS in Surat points out that the terms of acquisition and other procedures were never orally explained to the people in the Sardar Sarovar project and in the process illiterate people were cheated by the officers and their intermediaries, except in cases where activists of voluntary organisations came to their help.

Even when compensation is paid to villagers through their bank accounts, it has been found that part of it goes in sustaining them during the shift to a new site and much of the rest is frittered away in non-productive expenditure. Another problem is that the government takes only land which is to be submerged or is required for other purposes, leaving many partly affected people in the lurch. When part of a village is shifted elsewhere, the families left behind face a life of isolation. In some cases, when the major portion of a families land is taken over, it can neither survive on the remaining area nor get any compensation for the remaining land or for its house if it decides to shift along with fellow villagers.

Such cases were never considered until the Narmada tribunal specified that if 75 per cent of a family's land was affected, the entire land should be taken over and it should also be paid compensation for the house and transport for shifting. Even now, there is no provision for families who are isolated in partly affected villages. Almost all the farmers left in the vicinity of Shivsagar (Koyna) reservoir live in scattered bastis below the poverty line as they have no means of subsistence except for a few quintals of paddy grown by primitive methods.

### Resettlement problems

"Land for land" is a better policy than cash settlement and the Narmada tribunal has in fact specified that a minimum of 5 acres should be given to each affected family. Even in implementing this policy, the land is not given in the command area—in most cases, forest land is either cleared or waste fallow land given without any provision for developing the land or for the supply of necessary inputs; a village is broken up and families dispersed; villagers are usually left to buy private land and take loans from the government, which puts poor villagers at a disadvantage—land prices in neighbouring villages shoot up steeply; if the government takes up resettlement, the villagers are resettled in distant places, sometimes in a totally alien environment and culture, thus creating insurmountable adjustment problems.

Oustees from Pong dam in Himachal Pradesh were settled in Anupgarh in Rajasthan, bordering on Pakistan. Though the land falls in the command area of the Rajasthan canal the villagers, who were used to hill cultivation, found it difficult to adjust to the rigours of the desert (see box).

Tribals affected by Inchampalli and Bhopalpatnam in Maharashtra do not even speak Marathi and if they are resettled away from forests and in an alien Marathi-speaking area, they will find it difficult to survive. Shifting them to any other area would amount to 'ethnocide', in the words of Baba Amte, the social activist who has been leading a mass movement against the two dams.

When the construction schedule of a dam is planned, residential quarters for officers and other staff are always given priority. In the Sardar Sarovar project, Kevadia colony, a well-developed residential area with markets, schools, parks and other facilities was kept ready before the staff moved in. On the other hand, when villagers were served legal notices for acquisition of lands, no preparation was made for their shift to alternative sites. Even if some sites were located, no effort was made to develop the sites. The people were generally left to fend for themselves. Arrangements for drinking water, dispensaries, schools, village roads or drainage at the rehabilitation sites are only completed years later.

### Helping hands

In the case of the Ukai dam in Gujarat, resettlement work was undertaken by the Ukai Nav Nirman Samiti, a voluntary agency. What is more, the then chief minister of Gujarat belonged to the same district. Even so, out of a total of 18,500 affected families, only 3,500 families could be resettled. Though Rs 7 crore was paid as compensation, only Rs one crore was deposited in banks, the rest being squandered or used for day-to-day needs. In the case of the Koyna dam, when a survey of displaced people was conducted by Deccan College in Pune in 1969, it was found that around 12 families from practically every village had returned to their neighbourhood.

Since those who are displaced are the illiterate and unorganised rural poor, they do not have any political clout. Whenever they have been organised with outside help, they have succeeded in getting a better deal. The Ukai Nav Nirman Samiti handled the rehabilitation with some success with the support of the then chief minister of Gujarat. Baba Amte in Gadchiroli district, Maharashtra, and the Koel-Karo

**In dissent against another dam, Madia tribals marched down Gadchiroli town in 1984 to protest against the massive Bhopalpatnam-Inchampalli projects. (Darryl D'Monte)**

### Ping Pong

When the dams come, one of the problems they bring with them is this: what is to be done with the thousands of people their waters displace? The obvious way out is to resettle them. However, the exodus doesn't always work out the way it was meant to.

The Pong dam on the Beas in the Kangra area of Himachal Pradesh is a case in point. Construction began in 1960 and by 1970-71 its waters had drowned all the land they were likely to drown, about 75,000 acres. The land, belonging to about 30,000 families, had been acquired as far back as 1960-61, and in return the families were to get land in Rajasthan, and be resettled in 1,356 villages.

Only 16,100 families were actually considered eligible to receive the promised 25 to 30 acres each in the Rajasthan Canal command area, at concessional rates. For the land they had left behind, they were offered Rs 700 per acre of irrigated land and Rs 200 per acre of unirrigated land, but the villagers moved the court and the compensation was doubled.

Both the old land and the new land had strings attached to it: compensation was paid only to those who filed the necessary papers before a certain date, and a large number of families were left out. As for the alternative land, only 6,800 of the 16,100 eligible families actually took possession. They were supposed to start cultivating it within six months—a stringent condition which 5,600 families were not able to satisfy and finally, only 1,200 families or 4 per cent of those displaced were actually resettled. In early 1982, the authorities unbent, but only a bit: full ownership was to be awarded in 10 years instead of 20, and the 5,600 families who had lost their land could appeal within 60 days to have the cancellations of their leases revoked.

This mass of gloomy statistics tells only part of the story. On the ground, the tale was one of unrelenting misery. When the displaced persons started arriving in 1970-71, at Ghadsana, their new home they found was a desert devoid of electricity, water and other basic amenities. To get their wheat milled into flour, they had to travel to Anupgarh, 38 km away. The local people were understandably hostile, and the Indo-Pakistan border was just a deadly bullet away. On top of that, the people had to make dozens of trips to Bikaner or Ganganagar or Anupgarh to get their land allotted or reallotted. Corruption was rampant and money passed freely under the table before things got done. As Dr Basant Gulleria, formerly of Dehra in Kangra district, put it: "it was like kala pani".

One reason for this was that the Rajasthan Canal arrived in the area only half a decade after the refugees from Himachal Pradesh did. Secondly, the strict conditions must have made the place seem like a prison: one was that people had to be at home when the patwari came calling. No wonder that most of the poor people, who formed the vast majority of this particular exodus, sold their land. Only a few well-to-do Rajput and Ghirith families managed to defeat adversity and stay, but these were just 25 per cent of the total.

The problems are never ending. The main one is that the land allotted is less than the amount promised. The list continues by noting the lack of a school—the children go to Ghadsana—no potable water, insufficient irrigation as they are at the tail end of the canal, and land too close to the frontier for comfort—sometimes, while ploughing, the front end of the tractor enters Pakistan. Diseases are rampant and medical facilities non-existent, not counting the quack shops which are doing good business. On top of this, many powerful officers and politicians covet the land.

In fact, local politicians and businessmen are using the state machinery to harass the allottees. The land of those whose deeds were cancelled was sold to local people at high prices. At the same time, big investors are trying to persuade the allottees to sell off their plots at low prices. In these circumstances only the fittest can survive.

The survivors have been given house plots far away from the farms. There are no link roads and transport is inadequate. In spite of all this, they have managed to make the desert bloom and are now taking in two crops a year, cultivating cotton, wheat, and mustard.

Every person makes an average of three trips a year to Kangra to ensure that the old ties continue: the families of some allottees have stayed behind on account of the children's education. This generation at least will maintain links with their now submerged homeland. The next will have a new home.

Jana Sangathan near Ranchi, Bihar, are raising issues which are fundamental to a rehabilitation policy.

The Koel Karo people are demanding that the government spell out a comprehensive rehabilitation policy—economic, social and cultural—to the satisfaction of the people affected by the project. The struggle committee consists of heads of all the villages involved and they have succeeded in stalling the construction of even the approach roads to the dam site. The state government has been forced to enter into negotiations with the people's representatives. The proposal put forward by the state government includes reservations for the displaced people in Class III and Class IV jobs and setting up of vocational training facilities for the youth but provision of land-for-land is not part of the deal.

In Gujarat, four voluntary agencies have been involved in rehabilitating the villagers displaced by Sardar Sarovar on the Narmada. Chhatra Yuva Sangharsh Vahini volunteers have gone into the villages to educate villagers about compensation and rehabilitation and mobilise them against corruption and for a better deal in accordance with the Narmada Tribunal Award. The Action Research in Community Health and Development group of Mangrol and the Rajpipla Social Service Society are working in cooperation with the Sangharsh Vahini and are liasing between the people and state government. The CSS in Surat has done commendable work in studying each affected village in detail, and indicating the rehabilitation requirements of the people.

### Rehabilitation Policy

A comprehensive rehabilitation policy can be spelt out only when development is understood as a process which benefits the people. If the completion of a project at the minimum cost becomes the overriding objective, rehabilitation simply amounts to evacuation. People who could previously barely manage to survive in their traditional environment are uprooted as a result. If people are the major focus, any project should seek to improve the conditions of those living in abject poverty.

According to the CSS, the objectives of rehabilitation should be:

- The people displaced should get an appropriate share in the fruits of development.
- they should be rehabilitated by creating new settlements within their own environment.
- Removal of poverty should also be an objective of the rehabilitation policy and therefore some land to all oustees (even to the landless) should be given with assurance of employment.

While dealing with tribals one should also keep in mind the following five principles of tribal development, accepted during Jawaharlal Nehru's era as 'tribal-panchsheel':

- Tribals should develop along the lines of their own genius and we should avoid imposing anything on

## Himalayan Blunders

### Vishnuprayag

The government juggernaut is usually thought to be unstoppable. Not so: the scrapping of the Silent Valley massacre in the south proved that. Now, in the north, another ambitiously grandiose power project is in limbo because of the sustained opposition mounted against it by a group of determined environmentalists. That project is the Vishnuprayag dam—touted to be the highest in Asia—a few kilometres downstream of the revered Badrinath temple on the Alaknanda river. This Rs 266 crore enterprise was expected to produce 480 mw of power and substantially ease the perennial energy crisis in the region. The man who has been leading the crusade is Chandi Prasad Bhatt, the Chipko leader. Today, the fate of Vishnuprayag is in the hands of the Planning Commission , after a period of bureaucratic buckpassing which included the Planning Commission—which originally cleared it—and the Uttar Pradesh Irrigation Department.

The basic plan is quite ingenious. The Vishnuprayag barrage, 56 metres in width, feeds a 12 km tunnel which emerges opposite Joshimath town. The water then takes a 943 metre plunge down the gorge to an underground power station. To enhance the flow at Vishnuprayag, a diversion barrage on the Alaknanda's tributary Pushpavati diverts its waters into a 7.5 km tunnel which connects the barrage with its Vishnuprayag counterpart. The idea of linking the two rivers was taken up in January 1982 when it was discovered that the Alaknanda alone would be unable to generate enough power and the capacity was hiked from 262 mw to 480 mw.

Unfortunately, this network is meant for one of the most ecologically sensitive regions in India. For one, the project entails considerable expansion and dislocation around the Joshimath township, already situated on an ancient landslide zone and quite shaken up by the blasting over the last several years. Disturbed by reports that the town was slipping—it rests on sand and stones, not on base rock—experts had recommended a ban on heavy construction activity in the areas. But it appears that this advice was ignored and during the time that work on Vishnuprayag continued, the powerful explosions shook the entire mountain regularly.

Next on the list of endangered areas is the Valley of Flowers. Pushpavati passes through the Bhyunder Valley, which constitutes the lower part of the Valley of Flowers. Already the tourist influx has seriously threatened the delicately balanced ecology of the area. The construction of the tunnel as well as a 10 km motorable road will be a major blow whose consequences could be felt in both the Bhyunder Valley and the northern part of the Valley of Flowers. As it is the 500-odd species of rare Himalayan flowers which flourished here at the turn of the century have dwindled to 50.

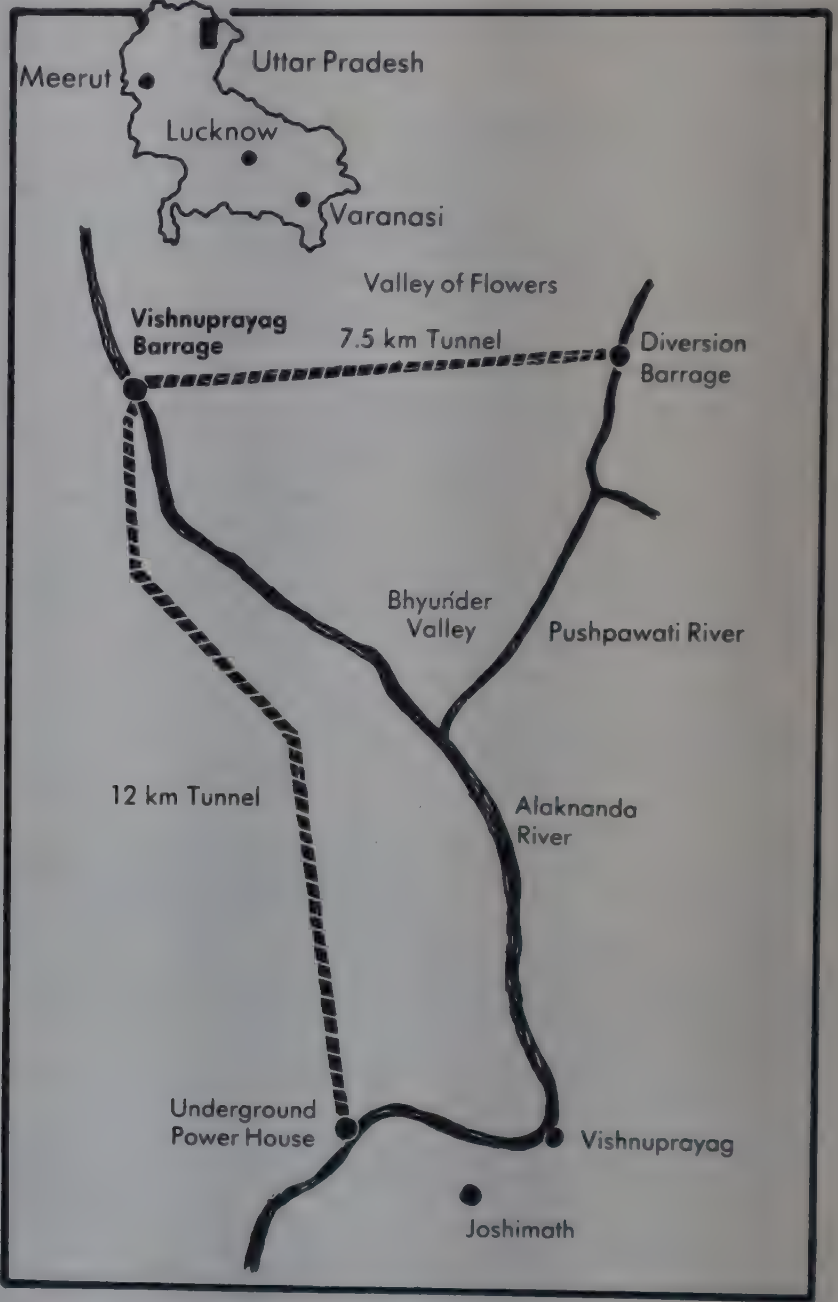
What is more, the dislocation might not even deliver the power it is supposed to. Last year, Bhatt hired two geologists to examine the region. They report that the government has made no serious study of the site. More significantly, they assert that parts of the Vishnuprayag area are prone to be swamped in glacier debris, known as moraine deposits, which could seriously affect the functioning of the barrage.

That is not all. Even the combined power of the rivers may not be enough to keep the turbines humming. All four turbines would generate power in the three months of the monsoon. However, between November and April, the water level in the Alaknanda drops steeply and the geologists estimate that it could deliver just enough water to keep one turbine in business.

The environmentalists fighting the project have first hand experience of the results of tampering indiscriminately with nature. In 1970, as a result of regular deforestation over the years, the swollen Alaknanda devastated vast areas. What was worse, it deposited silt all along the Ganga canal and the clean-up cost in three districts of Uttar Pradesh came to Rs one crore.

The government has until now spent Rs 10 crore on roads, buildings and exploratory surveys. There also seems to be some confusion in high places: in July 1983, the Prime Minister categorically stated that the government was going ahead with the project but the Department of Environment is reportedly putting together an experts committee to look into it from scratch. This is a welcome break for Bhatt and his team but for the moment they are keeping their fingers firmly crossed.

**Vishnuprayag Hydroelectric Project**



### Western Himalayan dams

The majestic ranges of the Himalayas are the fountainheads of many of India's greatest rivers. For as long as anyone can remember, the snow-topped mountains and the ancient streams they give birth to have been thought to be a repository of divine power. That is as it may be, but there is no doubt that the Ganga-Yamuna basin in the Himalayas is an untapped Pandora's box of immense amounts of energy. The hydro-power potential of the area has been estimated at 30,000 mw—16,000 mw in India, 11,000 mw in Nepal and the remaining 3,000 on the border between the two countries. The large snowfed catchment areas drained by these two rivers ensure a substantial supply of water except in winter.

Hence the concerted drive to put the rivers to work to feed the energy-hungry plains. At present, there are four projects already delivering power: Chilla (Rishikesh), Dhakrani-Dhalipur, Chibro and Kulhal, which cost slightly over Rs 200 crore and produce 498.75 mw. Projects under construction are the three-stage Maneri Bhali on the Bhagirathi near Uttarkashi (Rs 281.2 crore, 575 mw); the massive Tehri dam, also on the Bhagirathi (Rs 827.30 crore, 2000 mw); and Vishnuprayag on the

Alaknanda (Rs 266.64 crore, 480 mw).

Schemes already submitted and being vetted are Pala-Maneri on the Bhagirathi (Rs 1,059.54 crore; 1,323 mw); a barrage at Srinagar on the Alaknanda (Rs 144.18 crore, 200 mw); Loharnag-Pala on the Bhagirathi; Kishau at Tons – held up because of a dispute between Uttar Pradesh and Himachal Pradesh; and Kalapather. Schemes under investigation are Koleshwar, a balancing reservoir for the Tehri Project which will generate 150 mw on its own; Kotlibahel (Rs 118 crore, 100 mw); Bawla Nand Prayag and Lakhwar-Vyasi (300 mw and 150 mw); and Utyasu near Karnaprayag (900 mw).

The ecological cost of such leaps and bounds of progress will be very high. The Utyasu dam, for instance will destroy about 100 villages as well as Karnaprayag town; in all, about 60,000 people will be affected. When the Kotlibahel dam is complete the pilgrimage resort of Devprayag will be submerged. But the most controversial project of them all is undoubtedly the Tehri dam, a landmark in dam technology, one of the highest dams in the world with an installed capacity of 2,000 mw.

Such enormous potential poses enormous problems. The basic stand of the Tehri Bandh Virodhi movement is that the dam is a major threat to a region whose ecology has already suffered several shocks because of relentless deforestation and construction. The first victim of the dam will be Tehri town itself and 23 surrounding villages. About 35,000 people, including 8,000 from Tehri, will have to be rehabilitated and although another township is being built at Badshai Thol, officials admit that resettling the villagers is proving unusually difficult because only half of the required forest area has been acquired and no more can be got because of the Forest Conservation Act of 1982.

Then, it argues that the region is seismically sensitive and that constructing such a massive structure there, with all the additional geological dislocation that would entail, could be courting disaster. Dr S.P. Nautiyal, former president of the Wadia Institute of Himalayan Geology says that the rocks of the region are highly fissile and would not provide a suitable foundation for a dam of such colossal dimensions.

Thirdly, the powers that be appear to have forgotten all about afforestation when they approved the dam. Already the silt content of the rivers is very high and if afforestation is not taken up seriously the life of the dam might not be more than 25 years. The government was prodded into providing Rs 10 crore for afforestation not very long ago and, according to the scheme outlining the programme, it will take six years to complete the work. The dam is expected to be commissioned by the early 1990s which means that at the moment it is virtually a race against time.

The Tehri dam and the furious controversy it has aroused encapsulates the debate raging over the exploitation of the Ganga-Yamuna Himalayan basin. Chipko warrior Chandi Prasad Bhatt, for one, has been in the forefront of the conservationists who argue that such accelerated development could end up destroying the very environment that it is trying to take advantage of. He does not say that the region should be left untouched, but advises that a proper survey of all aspects of the environment be done because the consequences of hasty construction could be immense – and irrevocable. As he commented in a newspaper article: "To ensure development without destruction, care must be taken to maintain a proper balance between the many projects under construction . . . .and the environment." Elsewhere he has cited the indiscriminate use of explosives to blast roads and forests, leading to landslides and further erosion.

As part of his programme to preserve Himalayan ecology as much as possible, Bhatt proposes, among other things: a high-powered official survey team, consisting of experts and social workers, to examine the catchment areas in detail, especially areas affected by landslides and soil erosion and those where the construction pressure will be the highest; a ban on tree-felling in catchment areas, with particular attention to broad-leaved tree forests which are essential to a river's life; afforestation on a priority basis; and another ban on dynamite and other construction explosives.

There does not seem to have been any response to this eminently sensible plan. The government has its own compulsions: an energy shortage which the numerous projects taming the Himalayan rivers will do a lot to alleviate. But it has gone about its power-grabbing exercise with an unhealthy disregard for the feelings of the people and the sensitivities of an environment which has already suffered, and may continue to do so in the future.

## Northeastern dams

The Brahmaputra is a powerful, turbulent river which periodically bursts its banks and wreaks havoc along its course. Taming it and its tributaries in the Northeast would, it is estimated, deliver more than 21,000 mw of power. However, tapping this reservoir requires the close cooperation of India, Nepal and Bangladesh and until such time as such cooperation can be achieved the Indian power brokers have satisfied themselves with identifying 4,000 mw worth of hydroelectric projects in the regions.

One of them is the Kopili project at Garampani in Meghalaya, about 200 km from Shillong on the Meghalaya-Assam border. A combination of two dams and two tunnels is expected to deliver 150 mw at a cost of Rs 150 crore. In the second stage, the installed capacity will rise to 300 mw at an additional cost of Rs 50 crore. Environmental damage is inevitable, as the project—which will harness both the Kopili river and Unrong stream—are set in the midst of thick forests. The agency in charge is the Central government's North Eastern Electric Power Corporation Ltd (NEEPCO), which is also investigating three other projects with a total installed capacity of just under 1,000 mw.

Caution is the watchword in the Northeast, especially after the accident of the Loktak dam in Manipur. Commissioned in 1983, the Rs 150 crore project essentially takes the waters of a human-made lake down a steep drop to a power station of 105 mw installed capacity. It is also supposed to irrigate 24,000 hectares. Barely three months after water started flowing through the 6.5 km tunnel to the power station, a 23-metre length of the tunnel collapsed; there were landslides and cracks appeared in the mountain carrying the tunnel.

There are two theories for the disaster: that unchecked deforestation weakened the ground, leading to the collapse, or that heavy seepage caused by the creation of the lake destabilised the weak structure of the mountain. Whatever the reason, the Loktak experience cannot but give some anxious moments to the engineers working on the Rs 50 crore Thaubal dam, also situated in a geologically unstable area and of much the same basic design as the Loktak dam; the Rs 12 crore Khuga dam, and the Rs 25 crore Singda dam, meant to feed Imphal with water, are all plagued with landslides which have put a stop to construction work.

As is the case everywhere with big dams, the cost in terms of human dislocation is a major factor. The Dihang hydel project in Arunachal Pradesh is a case in point. With a total installed capacity of an incredible 20,000 mw—almost half of India's total installed power capacity today—the 300 metre dam across the Siang river will drown nearly 500 sq km of fertile land, including 91 villages and three towns. The Dihang dam, by far the largest ever contemplated in India, will store more than four times the water stored by Bhakra or three times by Nagarjunasagar. Chief Minister Gagong Apang does not exaggerate when he says: "We cannot agree to a project like Dihang as it would affect the lifestyle, culture and environment of almost one-sixth of the population of this sensitive area."

Just how sensitive the area is will come to light in 1985, after an extensive and exhaustive survey to locate earthquake prone spots in the Kumaon-Garhwal area, the Northeastern region and Kashmir. An observation network of 13 stations has been set up to collect and analyse data. Dr D.K. Rakshit, one of the coordinators of the programme, emphasised that the Himalayas were exposed to earthquake hazards and as such it was necessary to get acquainted with the seismic condition of the region. He might have added: before blasting its rocks to release the power of its waters.

**The Himalayan river Chenab gets dammed — the Salal project in Kashmir.**

them.

- We should try to encourage their own traditional arts and culture in every way.
- Tribal rights in land and forests should be preserved.
- We should try to train a team of their own people to do the work of administration and development.
- We should try to train a team of their own people to do the work of administration and development and should not overadminister these areas or overwhelm them with a multiplicity of schemes but
- should rather work through, and not in rivalry with, their own social and cultural institutions.

Keeping these in view the following general guidelines can be specified for any rehabilitation programme:

- Land for land should be provided with an economically viable minimum of 5 acres even to the landless.
- Resettlement should be in the neighbourhood of their own environment.
- If resettlement is not possible in the command area, top priority should be given to the development of irrigation facilities and supply of basic inputs for agriculture; drinking water wells, grazing grounds for cattle, schools for the children, primary health care units and other amenities should be arranged.
- In partly affected villages, villagers should be given the option of shifting out with others with the same compensation available to evacuees.
- Training facilities should be set up to upgrade the skills of affected people and reservation in jobs should be made for the willing adults among the evacuees. Special attention should be given to the rehabilitation of artisans and village craftspeople.
- Villagers should be taken into confidence at every stage of implementation and they should be educated, through open meetings and discussions, about the legalities of the Land Acquisition Act and other rehabilitation provisions.
- The aid of voluntary agencies should be taken in the planning and implementation of the rehabilitation programme.

It can be argued that it is inevitable that any development project will benefit some citizens more than others and invariably some citizens may have to bear the additional cost. In the case of big dams, like most other development projects, the direct beneficiaries are generally the rural rich and the educated urban elites, whereas the direct social costs are borne by the rural poor, mainly tribals. If people who pay the social costs start to count in the development strategy, the entire orientation of the planning process will have to change.

## Alternatives to big dams

Storage of water by building large dams is regarded by irrigation engineers as a crucial component of India's water management system. The Central Water Commission argues that benefits like hydroelectricity, irrigation, flood control, industrial and municipal water supply are not possible "unless the water is stored in reservoirs created by dams" Water storage is necessary because rainfall is very unevenly distributed, varying from 10,000 mm in Cherapunji to about 100 mm in western parts of Rajasthan. There are also considerable seasonal variations. Over 75 per cent of the rainfall is received during the monsoon period of June to October and even during this period there are many erratic spells of heavy rain and dry weather. On one hand, as many as 99 districts are classified as drought-prone; on the other, 85 per cent to 90 per cent of the monsoon water flows waste to the sea.

Since independence, about 700 storage dams have been constructed. The total storage capacity created so far, including those of small tanks, is assessed to be about 16 million hectare-metre. Out of a total of 178 mham surface water available in the country, only 27 mham are now being used and the utilisable potential is about 67 mham. About 90 per cent of the water being used is for irrigation alone.

By the year 2000, the government hopes to provide irrigation to 113 million hectares, the ultimate irrigation potential out of a gross cropped area of 200 million hectares. Major and medium irrigation projects would irrigate about 58.4 million hectares and minor irrigation projects 54.6 million hectares. Between 1980 and 2000, some Rs 60,000 crore (at 1980 prices) will be required for the development of this irrigation potential. At the beginning of the sixth plan, a total potential of 56.51 million hectares had been created of which 26.61 million hectares was through major and medium schemes and the rest through minor irrigation.

By June 1984, about 65.5 million hectares of irrigation potential had been created.

**Potential capacity**

As even by the year 2000 nearly 40 per cent of cropped area will be unirrigated, the government is preparing a national perspective plan for water resources development, which will allow for large scale inter-basin transfer of water from water surplus river basins to water scarce river basins. This will mean that an additional 22 mham can be utilised. But these inter-basin transfers of water will again depend primarily on the creation of storage reservoirs: the ultimate storage capacity in that case has been assessed at 37.5 mham.

The irrigation potential will thus increase from 113 million hectares to 148 million hectares, with about 25 million hectares coming under surface schemes and about 10 million hectares benefiting from increased use of groundwater. This ambitious plan will require an investment of about Rs 50,000 crore. The investigation and planning work of the National Water Development Agency charged with the development of the perspective plan will cost Rs 107 crore spread over seven to 10 years.

The commission argues that if water resources have to be harnessed by building storage reservoirs then either developed areas with a large population, agricultural areas, or forest areas with a tribal population have to be submerged: ... "If none of these are to be affected ... we may have to stop all further progress in water resources development".

Thus, if government programmes go ahead as scheduled, there will be hardly any free-flowing rivers left in the country. Already the Cauvery is fully exploited. The Krishna and Godavari rivers, with large dams like Tungabhadra, Srisailam, Nagarjunasagar, Mula, Jayakwadi completed or near completion and several new rivers in the offing like Inchampalli and Polavaram should be fully exploited soon. With the award of the Narmada Tribunal, the Narmada valley development programme has also been launched and by the early part of the next century, the Narmada will be a fully controlled river. The Tapti with Ukai and Upper Tapti dams will soon become a fully used river. Mahi with Bajajsagar and Kadana dams faces the same prospect, and so does the Betwa with Paricha, Dhukwan, Orchha, Matatila and Rajghat dams.

## Small is Powerful

There are thousands of places in the hilly regions of India where small hydroelectric power generators ranging from a few kilowatts to several megawatts could easily serve remote rural settlements. But small hydropower development in India has been almost totally neglected, although the first small hydroelectric plant of 200 kw capacity, was installed at Darjeeling in 1887.

In comparison, China had over 88,000 small hydro-power stations with a total installed capacity of 6,929 mw in 1980 which generated approximately one-third of all the electricity consumed in rural areas in that year. Over 86,000 stations had an installed capacity of less than 0.5 mw each, and accounted for 60 per cent of the total installed capacity of small hydro units.

Smaller units can be built, maintained and operated by rural communities and need not become part of the national grid. A 0.5 mw station can energise 100-watt bulbs in 5,000 households; in other words a small hill village can be well off even with a 0.1 mw unit. However, in 1980, India had an installed capacity of only 220 mw in small hydro units, most of them in Uttar Pradesh, Himachal Pradesh, Jammu and Kashmir, Arunachal Pradesh, West Bengal and Sikkim. These units ranged in size from 5 kw to 6,800 kw. Less than 10 per cent of the installed capacity was represented by units of a size less than 500 kw, and less than 2 per cent was in units of sizes of 100 kw or less, which are actually classified as micro hydel units.

A detailed survey of small hydro potential has yet to be conducted. According to an official estimate, this potential is about 2,000 mw in the hilly areas but this is definitely an underestimate especially if sites for microhydel units—less than 100 kw—are included. Another 3,000 mw worth can be set up to utilise the small falls that dot irrigation canals in the plains.

According to the Central Electricity Authority, small hydel units work out costlier per kilowatt installed than larger hydel projects: between Rs 8,000 and Rs 15,000 as compared to Rs 3,000 to Rs 7,000. But the smaller the unit, the smaller the initial capital required and the gestation period. Most important, they can be operated by local communities without any national bureaucracy being involved.

In China, the people are encouraged to participate in small hydel development. A small station is financed mainly by the local community itself and subsidised—one-quarter to one-third of the total investment—by the government. In recent years, commune and brigade-run stations can be built with low interest loans from the Bank of Agriculture while country-run stations can obtain medium or short-term loans from the People's Bank of China. The small hydel plants are gradually integrated to form a local grid and eventually even integrated into the national grid when certain necessary conditions are satisfied.

In early 1983, the Ministry of Energy announced that Rs 100 crore—a pittance when compared to the money spent on large power projects—had been allocated by the Planning Commission for the promotion of small hydel units. But the commission soon back-tracked and told the ministry that state governments should find their own funds for small hydel units. Many engineers continue to argue that small hydel units are not economically viable and government should continue to invest exclusively in large hydel projects. Nevertheless, the Punjab government has announced its intention to set up a micro-hydel corporation and the Karnataka, Uttar Pradesh, Orissa and Mizoram governments have announced several small hydel schemes using low canal heads and sites in hilly areas.

Meanwhile, a number of voluntary organisations in the country have started experimenting with micro-hydel units. In Chamoli district of Uttar Pradesh, the Jakheswar Shikshan Sansthan has established a 10 kw unit at a cost of Rs 65,000, lower than government estimates. The unit powers flour mills, oil expellers and saw mills. The Tangsa Gram Swaraj Sangh near Gopeshwar has set up another 10 kw unit and in Tehri district, the Lok Jiwan Vikas Bharati has also established a small unit at Bhudha Kedar and it hopes to provide electricity even to households. The Garhwal University is also experimenting with a micro-hydel unit and the Roorkee University has successfully converted a traditional 'gharad' (water mill) into a 5 kw power unit.

Micro-hydel units offer enormous scope for local innovation. When Dr Virendra Kumar, a botanist who wanted to study the flora in the Valley of Flowers, needed electricity to power his incubator and microscope in the valley itself, a young engineer from IIT Delhi, Yogeshwar Kumar, got a local carpenter to build a wooden turbine and, with parts from a discarded truck, provided sufficient hydel power.

The main problem that these organisations face is spare parts. Equipment purchased from the cities has to be regularly repaired and serviced and every small snag becomes a crisis. Once the local people are trained in servicing and operating the small stations—and even to introduce homemade innovations—there is no reason why the units should not turn out to be a really pragmatic and environmentally healthy answer to local power shortages.

The waters of the Sone with Bamraha, Bansagar, Sukhar, Churhat, Hurma, Rihand and Kanhar will have been bottled up by 1995. The Mahanadi with Dudhawa, Ravishankarsagar, Hasdeo, Jonk, Arpa, Sheonath, Pairi, Hirakud and Tikkarpara dams will have been mostly used up in the next 20 years. The rivers in the Indus Basin, Sutlej, Beas and Ravi are also being controlled and the northern tributaries of the Ganga (Bhagirathi, Sharda, Ghagra and Kosi) too are likely to be fully exploited by the turn of the century.

### Emerging problems

But whatever the Central Water Commission may argue, more and more experts are beginning to question the very utility of big dams, and especially of the large surface irrigation schemes they offer to the country. In a study on canal irrigation and its impact on crop production and environment, D.R. Bhumbla, former agriculture commissioner and vice-chancellor of Haryana Agricultural University, argues that "from the experience of major and medium irrigation works in India, it is evident that its benefits in arid areas though spectacular for the first 10 to 20 years, gradually get reduced and a considerable portion of the land gets deteriorated because of waterlogging and salinity. In the humid areas, the benefits are doubtful from the beginning and in many cases negative. The programmes of major and medium irrigation works as has been envisaged for future in humid areas, in my opinion, would not only lead to disastrous consequences in degradation of soil and environment, but would also result in reduced agricultural production. It is time to halt the expansion of these programmes ...."

In low rainfall areas of Rajasthan and similar areas of Punjab and Haryana (300 mm to 400 mm), canal irrigation is necessary because raising crops without irrigation is either not possible or uneconomical. Moreover, the groundwater is saline in many areas and hence the potential for tubewell irrigation is limited. The introduction of canals in these areas has resulted in a significant increase in yields of crops like cotton in the kharif season and wheat in the rabi. In semi-arid regions of Tamil Nadu, Andhra Pradesh and Karnataka, where rice and sugarcane are the main irrigated crops, increases in yields have been significant.

But in all these areas waterlogging and soil salinisation have emerged as serious problems. As far as unlined canals and distributaries are concerned, a study by the Central Water and Power Commission in 1967 revealed that about 71 per cent of the water is lost in transit from the reservoir to the field.

**Loss of water from unlined canals due to seepage (per cent)**

| | |
|---|---|
| Canals | 15 |
| Distributaries | 7 |
| Watercourses | 22 |
| Field Losses | 27 |
| Total Loss | 71 |

Source : Interim Report, National Committee on the Use of Plastics in Agriculture, 1982.

### Increasing waterlogging

The water table in the Bhakra canal command area has been rising at the rate of about one metre per year. The managing director of the Haryana State Minor Irrigation and Tubewell Corporation in a press conference in late 1983 expressed serious concern over the rising groundwater table in the state. He said that 65 per cent of the area in the state covered by canal commands had saline groundwater aquifers underneath and in 4 lakh hectares, the water table had entered the critical zone of up to 3 metres depth. This was creating waterlogging accompanied by salinisation.

The rising water table will affect the production of many crops adversely. The story of canal irrigated areas of Pakistan where cotton has vanished from many fields, is likely to be repeated, says Bhumbla. The high water table, apart from affecting agricultural productivity, has many other adverse effects. Because of the loss of moisture storing capacity of the soil, even slight rains cause floods. The maintenance of roads and buildings becomes difficult and diseases increase because of waterlogging. In Hissar in Haryana, the load bearing strength of the soil has become less than 50 per cent in 15 years.

In the sub-humid and humid areas of the country (rainfall more than 1,000 mm), Bhumbla argues that the benefits of canal irrigation are questionable even in the short run. In

### Water, Water Everywhere

The Tawa Ayacut Development Authority has decided to install some 700 tubewells, not to irrigate the fields but to save them from the waterlogging caused by the canals of the Rs 300 crore Tawa dam. The dam and the waterlogging had sparked off the famous Mitti Bachao Abhiyan (Save the Soil Campaign) in the district of Hoshangabad in 1977 (SOE '82).

The first few tubewells have been installed in Pathori and Chandrapuri villages to stop the water table from rising further. This a small attempt by the Tawa project authorities, which is expected to irrigate some 4 lakh hectares in Hoshangabad district to rectify the problems created by the dam. Unofficial estimates now put the number of farms affected by waterlogging as about 15 per cent to 20 per cent of the total number of farms in the irrigated area. Even houses are being affected by waterlogging. Almost every house found in the depressed zone of the dam's command area has dampness round the year and some houses have started falling because of this continuous dampness.

When the canal is flowing, the approach roads to the villages situated in depressed zone disappear and the villages become imprisoned in a sea of water. Officials like the state's minister of irrigation and the local collector have all been caught in this muck and have disappeared after giving assurances to angry villagers. Nobody has yet found or implemented a solution to the increasingly worsening situation of farms, roads and houses. The dam that promised to increase the district's irrigated area from 1.3 to 60 per cent has only turned 60 per cent of the cultivated land in some areas into a bog.

The Mitti Bachao Abhiyan having gone through a phase of disappointments, is now getting rejuvenated again. The ayacut authorities dismissed the campaign as anti-development and several voluntary organisations said that it was not conscious of class differences in the area. But now that the fears expressed by the campaign are turning into reality, many farmers have begun a process of rethinking. Padyatras were organised in some 30 villages during 1983-84 in order to conduct surveys and organise the farmers. Kisan samitis are being formed in every village to conduct surveys and prepare an action programme. A postcard campaign has also been started in which farmers from different villages write at least one postcard every day to the collector about their problems. What big scientists of India were not able to achieve, these 7 inch postcards may now be able to do.

fact, in many areas, introduction of canals has resulted in reduction in productivity of crops. In Bihar, Madhya Pradesh and Orissa, which together have 2.5 million hectares of canal irrigated area, and where rice is the main irrigated crop, the yield per hectare is not only less than one tonne, but there has been no perceptible increase for the last 20 years. In Uttar Pradesh, which has the maximum canal irrigated area, there is a general complaint that in the canal irrigated area, apart from pre-sowing irrigation, hardly one irrigation is possible and the wheat crop frequently suffers from moisture stress.

During the drought of 1979-80, the farmers in the Sarda Sahayak command area complained there was no water in the canal but in the wet year of 1978, the canal water aggravated the flood problem created by excessive rain. In the rice growing area, water is seldom available for raising rice nurseries before the start of the monsoon rains. Thus, in the non-rainy season, winter or summer, when irrigation could result in significant increases in yield enough water is not available.

Further, in the humid areas, it becomes difficult to manage canal water during the rainy season and the problem of waterlogging becomes serious in a much shorter time. In fact, this may aggravate the problem of drainage and result in loss of production.

The situation is likely to be much worse as canal irrigation is introduced in high rainfall areas particularly if the soils have low permeability as has been demonstrated by the situation in Tawa and Barna command areas, where yields of all crops have declined since the introduction of canals. Bhumbla, therefore concludes: "The effect of canal irrigation on increasing cropping intensity is marginal." He argues that the irrigation departments do not even produce relevant data to show the cropping intensity in lands irrigated by canals and tubewells. All that we know is that in 1976–77, the net irrigated area was 34.8 million hectares and the gross irrigated area was 43.1 million hectares, which gives a cropping intensity of 1.24 which is very low and a good reason for the low productivity of irrigated lands in India.

Bhumbla argues that in most canal irrigated areas cropping intensity is less than that in tubewell irrigated areas, generally two or more. In other words, a substantial increase in food production in the last decade or so has actually come from tubewell irrigated areas. Bhumbla argues that the government should concentrate on groundwater development and management of rain water by storing it in catchment areas in small reservoirs instead of canal irrigation schemes.

### Small is beautiful

Groundwater development, minor irrigation schemes and mini and micro hydel projects are often cited as alternatives to big dams, but are looked down upon by power engineers and planners. Small schemes cannot be considered as alternatives to big dams for water management and power generation in all cases. But there is definitely a strong case for groundwater development and minor schemes for irrigation, while power generation needs can be partly met through small hydel projects.

Like surface water, groundwater resources in the country are being depleted because of the lower water retention in catchment areas which have been deprived of forest cover. The development of catchment areas, therefore, should become an integral part of an irrigation programme. This will also check the flow of silt into big reservoirs. There have been calls for the creation of a catchment area development authority.

**Net irrigated area by sources (million hectares)**

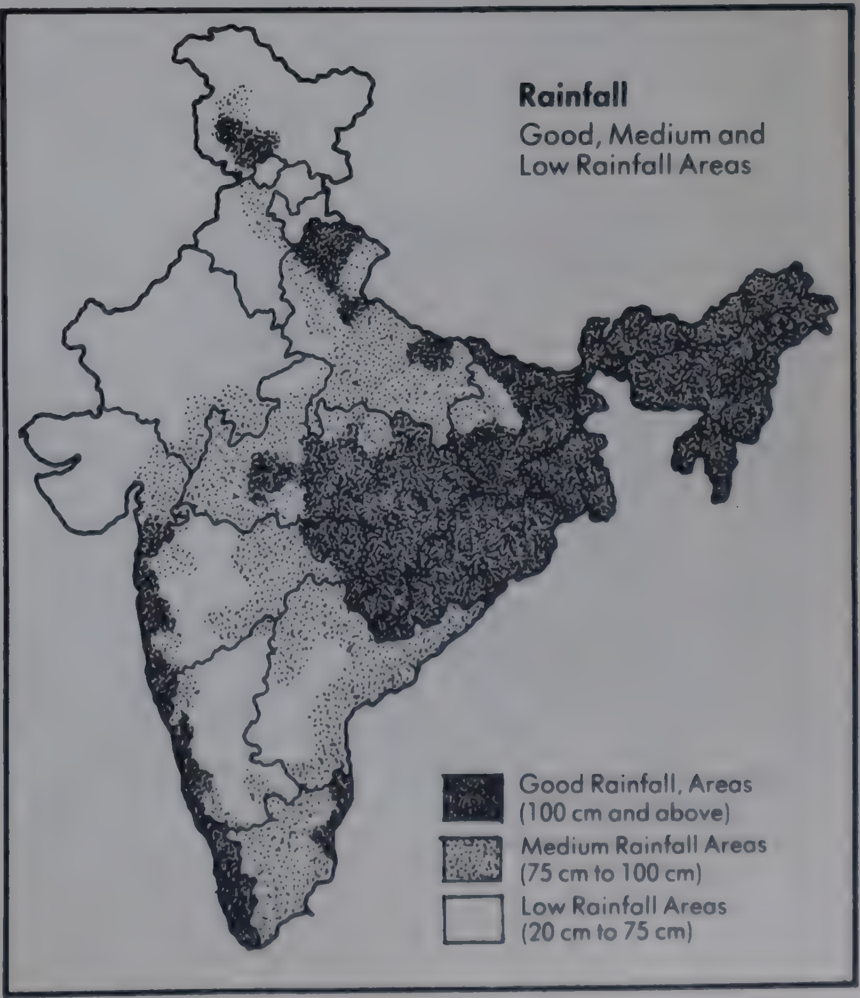
| | Canals | Tubewells | Total |
|---|---|---|---|
| 1950-51 | 8.3 | NA | 20.9 |
| 1960-61 | 10.4 | 0.13 | 24.7 |
| 1970-71 | 12.9 | 4.46 | 31.1 |
| 1978-79 | 15.0 | 8.2 | 38.0 |

Source: Indian Agriculture in Brief—18th Edition

Wherever water resources have been harnessed through small reservoirs by constructing bunds or small dams, the lives and environment of the people in the area have been transformed without anyone having to pay the cost of development. Whether it is through the voluntary efforts of Prembhai, recipient of the Jamnalal Bajaj Award for Rural Development, who has been instrumental in the construction of over 750 small dams in Mirzapur district of Uttar Pradesh or the initiative of P.R. Mishra, a soil conservation expert at Sukhomajri near Chandigarh, small dams have generated far more benefits than large irrigation schemes in terms of utilisation of water, improvement of agricultural productivity and ecological enhancement.

### Successful efforts

Prembhai claims that by constructing small bandhis (check dams) land belonging to the entire village has improved. A bandhi is constructed at an average cost of Rs 60,000 and


Rainfall
Good, Medium and Low Rainfall Areas
Good Rainfall, Areas (100 cm and above)
Medium Rainfall Areas (75 cm to 100 cm)
Low Rainfall Areas (20 cm to 75 cm)

## Bogged Down

Work on the world's largest irrigation system is bogged down in a chronic lack of funds, shortage of materials, political indecision and widespread corruption. Launched in 1958 as the answer to the problems of a drought-stricken state, the Rajasthan Canal with a planned length of 649 km and 6,500 km of distributaries is now over 500 km long; this includes a 204 km feeder canal which harnesses the waters of the Ravi and the Beas. Engineers are working round the clock to complete the second stage of the 445 km main canal.

Although the scheme was expected to be completed by 1968, it is unlikely to be ready even by the end of the century. The cost has shot up from Rs 66 crore to around Rs 1,000 crore by the time it will be ready, though allowance must be made for several revisions in the scope of the project.

But the biggest problem is waterlogging. Project authorities have discovered a thick hard layer or pan of gypsum at very shallow depths in the canal command area. According to Bhanwar Dan Bithu, superintending engineer of the project, around 8 per cent of the total command area of 7,000 sq km, about 500 sq km, is already waterlogged and at the present rate in the rise of the water table—2 ft a year—as much as a quarter of the entire area will be similarly affected.

Recent field studies, says Bithu, have shown that one-third of the command area has this thick layer and was likely to have a high water table once the area is intensively irrigated. Although the main canal is being lined with bricks to prevent heavy seepage, the authorities have decided not to line the distributaries and water courses in order to keep costs down. Kanwar Sain, the engineer who originally conceived the Rajasthan Canal, considers this decision "very unfortunate" Already a couple of villages near the head of the canal have been inundated and many people rendered homeless.

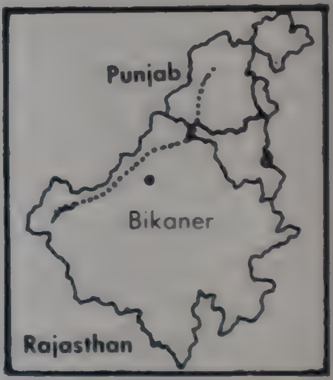
"The problem has taken everyone by surprise," says Chief Engineer Satya Pal Kashyap. In 1978, engineers had thought that there would be no waterlogging for at least another 200 years and no provision had been made for drainage. The presence of the pan, which lies below the soil at a depth of 5 ft to 20 ft, has drastically altered the situation. A senior engineer even feels that large tracts could be turned into marsh under intensive agriculture.

Kashyap, however, believes that waterlogging is a familiar feature in most irrigation projects throughout the world and can be properly tackled. Union Irrigation Minister Ram Nivas Mirdha has called for the introduction of modern methods of water application to minimise wastage and avoid ecological hazards in arid areas like most of Rajasthan. The sprinkler system, though it has a much higher initial cost, is suitable in certain conditions: Haryana has already installed over 10,000 sprinklers. The Central government provides subsidies for sprinkler and drip irrigation systems. But these can clearly not be applied to such a huge area as the Rajasthan canal command.

While project officials talk of immediate remedies, they have no long-term solution. Kanwar Sain says: "We do not seem to believe in the dictum 'prevention is better than cure'. All the suspect hard pan areas should be thoroughly studied before proceeding with construction works." An executive engineer concurs that there are techniques to combat waterlogging but adds that there was no need to get into this situation in the first place. As he puts it: "It would mean that we reclaim barren desert lands, then create waterlogging because of our shortsightedness and then go in again for reclamation of land."

The environmental "boomerang" extends further than waterlogging. With the greening of the Rajasthan desert, agriculture will replace a traditionally pastoral economy. The districts of Jaisalmer and Barmer, for instance, are famous as cattle-based economies and as much as one-fifth of Rajasthan's bovine wealth is concentrated there. Jaisalmer is nearly as large as Kerala, and, when irrigated will suddenly be able to cultivate a third of its area. "Almost 60 per cent of the area irrigated by the canal consists of excellent grazing lands," says Narendra Singh Bhati, former state canal minister. "The sewan grass that grows wild there has been found to have great nutritive value and hardiness." Sewan grass needs very little water: just a few inches of rain are sufficient to clothe the area with a lush growth.

The introduction of agriculture in the desert can prove disastrous for the cattle. Farming would be done on flat grazing lands to which it would be simple to bring water from the distributaries. Between waterlogging and agriculture,



**The Rajasthan Canal, which once promised to turn barren deserts into green fields, today threatens them with extensive waterlogging. (Bhawan Singh/India Today)**

therefore, little good pastoral land will remain. In the first stage of the project, only 12 per cent of the area was meant for forest lands which are earmarked for pasture and villagers allege that they find even this almost inaccessible to their cattle. The authorities charge a fee for allowing cows and sheep to graze, though they usually pocket some extra cash for the "favour". Goats are not allowed in these pasture lands.

Officials emphasise that the loss of grazing land is being exaggerated because only a limited portion of the affected districts comes in the canal zone. But when agriculture spreads to adjoining areas, the situation will be far worse. Sohan Lal Modi of the Bhoodan Sangh in Bikaner disputes official claims that grazing lands fall outside canal areas. "As it is, there is a big one-way traffic of cattle from the state; cows are being taken to Pakistan while young bulls and calves are being sent to the slaughter houses," he says. Once the pasture lands shrink, the migration of nomads is bound to increase.

One solution would be to restrict agriculture to the bare minimum in the second stage. Some suggest that the Rajasthan government should also go in for a mix of horticulture and cattle breeding, which would not upset the region's economy. The state has some of the best breeds of cattle in the country and the woollen factories of Mirzapur in Uttar Pradesh subsist on wool produced there. Modi points out that Rajasthan could set up its own Mirzapurs and Amuls.

Although the government has been promising to keep agriculture within limits, there is no clear policy about land use and cropping patterns or the preservation and development of pasturelands. Villagers in areas affected by the second stage have no illusions about the impact of agriculture; Atmaram of Bap village, 60 km from Bikaner, asks: "Once the irrigation starts and agriculture comes in, where will our cattle go?"

The problem can be illustrated through the example of Ganganagar district, where 80 per cent of the canal will flow through areas which have to be populated by settling people on newly-developed farm land. A Command Area Development Authority (CADA) was set up in 1974 to do just this and in the first stage land was allocated to 75,000 families; 98 per cent came from other regions. This means that people who traditionally used this land for pasture will be elbowed out. Nomads have always borne the brunt of big development projects and the Rajasthan Canal is no exception. As they do not possess land, they are deemed landless and hence no provision is ever made for them.

CADA has been concentrating on water management, as well as roadside and canalside afforestation, the development of townships and the building of water courses and minor channels to each chak or irrigation area. Recently, because of the hostile terrain, CADA is spending more than a third of its budget on afforestation to stabilise sand dunes. Some settlers have been allotted land but are unable to start farming because irrigation channels have not reached them yet. Some have fled. Similarly, in 1983, when Rajasthan faced its fifth drought in succession, some 50,000 people deserted dry districts along with their cattle.

While the chief minister and other politicians want the canal completed on schedule, it is doubtful if the funds required—Rs 70 crore a year till 1990—will be easily found. Gigantic schemes like the Rajasthan Canal beg the question whether it is really cost effective and environmentally sound to irrigate land on such a scale. The project calls for the deployment of 25,000 workers, 1,000 donkeys and 4,500 camel carts for 24 hours a day, not to mention 1.27 lakh tonnes of coal and 87,000 tonnes of cement last year alone.

It is important to recall that Rajasthan was a heavily forested region some centuries ago: overintensive farming led to the reduction of grazing land which in turn caused heavy deforestation. If the basic problem is the impoverishment of the soil, the answer must be to find ways of nursing it back to long-lived health. But, the Rajasthan Canal may actually bring about only a short-lived reprieve. Other means, on a smaller, localised scale, which call for greater participation on the part of local communities rather than their displacement may eventually prove more beneficial.

irrigates 40 acres. As a result of well-planned bandhis the cropping intensity in their project area, has increased by 60 per cent and agricultural production by 160 per cent. Because of improved water retention, even the forest has grown better. All the bandhis have been constructed entirely by local effort, thus giving employment to local people. In a bad monsoon, when the water dries up, desiltation is taken up and the fertile silt put back into the fields. Thus a farmer is helped even in the lean years.

At Sukhomajri, a small dam—two more were added later—was constructed at the foothill of a highly eroded ravine. The water provided irrigation to 80 acres of village land. Farm production improved and the farmers levelled and bunded their own land. Because of the increased yields, the availability of fodder from crop residue improved, reducing the grazing pressure on non-agricultural land. The improved micro-climate in the watershed saw the spectacular growth of trees, bushes and grasses in the forest. Villagers who used to be driven out of Sukhomajri by near-desert conditions during the lean season have now turned to growing fruit trees and vegetables to tide over the lean season.

Three rainfed reservoirs, varying between 200 feet and 400 feet in diameter, were created by constructing small earthen dams in the watershed area of the Sukhana river. This has brought about a total transformation in the life and environment of Sukhomajri village, 35 km north of Chandigarh. The implications of the project, basically a soil conservation effort to begin with, now embrace so many facets of development that Mishra, the project director, insists on calling it a comprehensive growth model and not just a model for tank technology, water harvesting, recycling or tree planting. The results are outstanding. The grass yield in the hill has shot up from less than 40 kg per year to more than 2,000 kg. Milk alone accounts for an increase of Rs 5 lakh in annual income. Now the village society is planning to establish hill-product-based village industries where the members of the society will get productive and more remunerative employment. Sukhomajri has shown that watershed management at the village level by construction of small dams has the potential of overall enhancement of the environment, without causing any destruction or displacement.

### Viable options

Very seldom are all technological options considered by irrigation planners. In a report submitted to the Department of Science and Technology on the environmental planning of Shahdol district, the Shahdol Group points out that in the context of the geography of the area there are five technical options: wells, ponds, small dams, cascade dams and major dams to harness the water in the district. Of these four are dependent on surface water management while the fifth (wells) is based on groundwater management. In an attempt to determine which is the optimal technology for the region the group has made a comparative assessment of the five technologies against several technical, economic, and social parametres. On the basis of this matrix, they argue that the system of cascade dams fits into the geographical and social characteristics of the region. But this is the one option of the five that the state government has totally ignored. On the contrary, major World bank-aided investments have been allocated for the development of wells and the construction of a large multipurpose dam on the Sone river. Both of which are unsuited to local developmental needs in terms of topography and available resources.

The government is building a major multipurpose dam at Deolong on the Sone called the Bansagar Hydel Project, to be completed by 1984 at an estimated cost of Rs. 320 crore. Some 1,27,000 people will be displaced and 51,648 hectares of land (two-thirds of which is cultivated and a fifth is forest) will be submerged. This has created enormous tension among the local population. The proposed ten townships for resettlement may never materialise and alternative employment may never be available as was the case with the nearby Rihand dam built on a tributary of the Sone. Most of the villagers are entirely ignorant of the schedules of evacuation, submergence and completion. Some farmers are hoping to get land in the command area of the dam and ask for immediate imposition of ceilings in the proposed command area before the beneficiaries of the region, mainly around Rewa and Sidhi districts of M.P. and some parts of U.P. rearrange their legal records to retain the irrigated land. The changed status of land from unirrigated to irrigated will make one-third to two-thirds of the land in the command areas available for distribution.

Wells and pumps are the other technical options in which banks have been asked to invest. But this option has neither looked into the technical features of availability of subsoil water and its management nor into the social aspects of land distribution and repayment capacities. Consequently, wells have been dug where no water is available; the size of the wells has been determined by standard specifications set by the banks rather than by water availability, in order to meet targets the loans have been given to larger farmers rather than to the small farmers for whom the money was originally intended; further as the number of wells dug increase, the groundwater level recedes thus negating the whole exercise of water development.

Apart from wells and large dams, ponds (which were mainly built in the days of the princely state) have been increasingly under pressure to change from domestic use to irrigation, pisciculture, and hydroponic cultivation ; thus resulting in a mismatch between design and utilisation and further increasing tensions within the village between ordinary villagers, rich farmers, and contractors. Small dams have never been seen as part of a river valley system and so their location has been technically faulty, subject to the whims of local leaders and a source of major revenue to petty contractors. As the government's own records show, these minor irrigation projects, designed for aiding kharif cultivation, have been used almost exclusively for rabi and, here too, actual coverage has reached only 30 per cent of targeted irrigation. And when all ongoing government schemes are taken into account, only about 5 per cent of the cropped area in the district will be irrigated.

Given the undulating topography, the system of cascade dams based on an integrated view of the total water resources available in a river valley provides a distinct alternative to the present schemes. Situated in the Vindhya range, a substantial amount of water can be stored by building small reservoirs on the nullahs (drains) which surround almost all villages. Several good sites exist where the runaway flows can be checked with little effort.

### Bhatsa Backlash

The Bhatsa dam on the Bhatsai river in Thane district of Maharashtra 107 km from Bombay, was completed in 1982. In May 1983, the reservoir of 264 million cubic metre capacity started filling up and on May 15, the first tremor shook nearby Khardi and other villages. In July and August 1983, as many as 900 tremors were recorded, with intensities of up to 4.2 on the Richter scale. The largest of the quakes, on August 17 and September 15, caused an exodus of 5,000 frightened villagers.

There seems to be no doubt that the 50 metre Bhatsa dam provoked the tremors. Even though there are two other dams nearby—Tansa and Lower Vaitarna—they have existed for 27 years and 90 years respectively and it was only when the Bhatsa reservoir began filling up that the ground started shaking. N.M. Aavad, a noted architect and engineer who studied the Koyna earthquake of 1967 in detail, feels that the situations are similar. The water in the Bhatsa reservoir could have seeped through the porous soil and come into contact with live Deccan lava, generating gases which caused seismic movement.

According to two other scientists, of the National Geophysical Research Institute, both the Koyna earthquake and the Bhatsa tremors were caused by the reactivation of rift valleys, deep geological faults beneath the Deccan trap. Bhatsa is said to be located near the junction of two rift trends and such structural junctions are known to be susceptible to earthquakes.

Whatever the reason, the tremors have caught the government napping, exposing the inadequate facilities for monitoring seismic activity in the area. The first seismograph was installed in July 1983, though seismic activity is indicated to have occurred since 1977 when water was first impounded at Bhatsa. Official experts say that there is no fear of a major earthquake as the dam has been designed to withstand ground movement during an earthquake and that large reservoir-induced quakes are normally associated with dams of 1,000 million cubic metre capacity and a height of 100 metres.

Today, the Bhatsa dam supplies 100 million gallons of water every day to Bombay. It is planned to raise its height to 88 metres to provide the metropolis with another 300 million gallons. Whatever the risks involved in such an expansion, Bombay's needs will probably take priority.

Flow irrigation is also possible in many sites. A number of villages can be served by shallow lifting devices. Others will need powered pumps. Existing tanks can be used or expanded where necessary. Several small storage schemes in the foothills are possible. Low stone masonry weirs could also be constructed across river beds to store monsoon waters in the river bed itself. The area to be irrigated being only 30 per cent of the total area of the catchment, it should be possible to meet the entire irrigation needs by properly harnessing as much precipitation as possible.

Similarly, the setting up of mini and micro hydel projects will prove to be a boon for the electrification and overall development of remote rural and hilly areas where power from the central grid can never reach them or will entail heavy transmission losses. A considerable portion of the hydropotential in fast-flowing hill streams, canals and river slopes can be tapped through small dams and small hydel schemes. Self-contained turbine generators can utilise even the normal flow of rivers in some cases.

These small schemes will probably receive their due only when the overall development of far flung rural areas becomes the focus of the country's planning. China is an oft-quoted example where thousands of small dams and mini hydel projects have been constructed which have provided water and power right at the point where they are needed and thus helped in overall development, ensuring basic amenities to the entire population. A much greater decentralised organisational effort is required to plan and implement schemes on the lines of China or of Sukhomajri or Mirzapur. On the other hand, large dams are constructed by centralised organisations and big contractors with huge funds borrowed from the World Bank and with imported machinery.

If irrigation alone is considered, small schemes are far better than large ones. But small hydel projects cannot meet the hydro requirements of the central power grid. The country will have to search for other sources of renewable energy because even so-called "clean" hydel is not so spotless if the destruction caused by big dams is analysed.

Ramachandra Singh Deo, former Madhya Pradesh irrigation minister has suggested that the construction of major reservoirs should be rescheduled. The building of minor or medium dams should start at the source of the river and proceed downwards. Major dams should be built only after the water and power resources upstream have been fully harnessed. Such a system combines the advantages of big and small dams. Deo argues that no new major projects should be launched for the next 20 years; only medium and minor irrigation schemes should be taken up and benefits of the irrigation capacity already created should be consolidated.

**Dam Dissent**

When completed, the Lalpur dam across the Heran river in Baroda district of Gujarat would have towered 146.3 metres above the surrounding countryside. The Rs 51 crore project with a reservoir capacity of 320 million cubic metres would have submerged 22 villages with a population of 11,346, and 4,300 hectares of irrigated land and 200 hectares of forest. Other victims would have included 315 wells and 43 primary schools.

But a vigorous campaign led by Harivallabh Parikh of the famous Rangpur Ashram, aided by influential Congress(I) leader Jinabhai Darji, and their direct contact with Mrs Gandhi, has led the government to suspend the project—though a final decision is yet to be taken. The alternative plan put forward envisages lowering the dam's height to 122 metres and constructing five smaller dams on the Heran at Khatuwant and Raipur and on its tributaries at Kara, Remi and Kukta. This plan is said to be more effective than the earlier one in that it poses less danger to the habitat of the predominantly tribal population of the area.

Critics of the dam are particularly incensed over the fact that it has a capacity of 320 million cubic metres because, when the Madhya Pradesh government develops the Heran catchment on its side, only 180 million cubic metres of water will be available for Lalpur.

As against this shortfall scenario, the complex of six dams laid out in the alternative plan is claimed to be much more sensible. One because it constantly maintains the base flow in the river all along its course, ensuring that drinking water is available throughout the year. Two a large number of small reservoirs at various altitudes will also add to groundwater recharge, supporting wells in the area.

As the people's agitation gathered momentum, the government had to take note of the growing opposition to the World Bank financed project. The Prime Minister directed the Irrigation Ministry, the Central Water Commission and the state government to discuss the implications of the project. The state was finally asked to conduct a survey of the alternatives, working in tandem with representatives of the people.

That the people feel strongly about the concrete monster planned for their region is made clear by the story of Devi Behn, an old lady of Moranna village who when she first learnt that a dam was to be built in her area made no secret of her joy that development had at last reached them. But a year later Devi Behn was dead—of shock, people said, when she learnt that her entire little world would be devastated. But others are carrying on the fight.

## Flash points

### The Koel Karo struggle

A potentially violent confrontation seems to be on the cards in Bihar over the Rs 600 crore Koel-Karo project, whose 710 mw capacity equals the entire state's current power generation capability. For years, tribals organised into the Koel Karo Jana Sangathan, made of people who will be displaced, have stalled construction, charging that the state government is deliberately underplaying the extent of inundation. According to their estimates, one lakh people in 15,000 families in about 100 villages will be affected. According to government estimates, around 50,000 acres of land will have to be acquired, out of which half will be agricultural, affecting 7,573 families in 50 villages. Both estimates are just guesstimates since even the government department has not been able to survey the area so far.

The project is to be constructed by the National Hydroelectric Power Corporation (NHPC) and envisages a 44 metre earthen dam across the South Koel river and a 55 metre dam on the North Karo river. The two reservoirs are to be linked by a 4.7 km channel. Preliminary surveys were done in 1954–55 and the project was approved by the Planning Commission in 1973. Almost simultaneously struggle committees came up in some of the villages likely to be affected. In 1974, these committees were coordinated into the Koel Karo Jana Sangathan by political activists of the Jharkhand Mukti Morcha and the Communist Party of India.

The Jana Sangathan fired a volley of demands to the state government. However, no concrete proposals of rehabilitation came back and the state government decided to go ahead early in 1978 with the construction of approach roads to the dam site. The tribals responded with a Kam Roko (stop work) movement: a barricade put up by the villages in 1978 on the approach road even today stands testimony to their resolve not to allow any government vehicle to reach the dam site. As a result, a tripartite meeting in 1978 conducted by the deputy commissioner of Ranchi decided to survey the affected families to prepare a rehabilitation scheme.

This plan was also soon buried. In October 1981, the government sent a formal proposal to the people, mentioning only compensation without any rehabilitation. Two technical training institutes were set up in 1981, with 75 per cent of the seats reserved for affected people. At least one person from each family would be absorbed in government jobs.

The Jana Sangathan was not satisfied. They demanded: land for land before construction; traditional rights and customs of tribals to be legally protected in the course of rehabilitation; and a concrete scheme for total rehabilitation.

The district collector sat down with Sangathan representatives in July 1983 and the government came out with a fresh proposal which included: cash compensation for land varying from Rs 8,000 to Rs 20,000 per acre; 0.25 acre of free land as house site for each displaced family; reservation in Class III and Class IV jobs in Chhota Nagpur area for the displaced; employment in NHPC and with its contractors for affected people—three-quarters of Class III and all the Class IV jobs reserved for them; people displaced to be rehabilitated in neighbouring villages – no more than a quarter of land in any village to be thus acquired; and full compensation paid into bank accounts and all amenities, drinking water, school, health centre and so on to be provided before evacuation.

By December 1983 the government and people had still not reached an agreement. Nearly 200 NHPC staff, including 35 qualified engineers, are twiddling their thumbs at Torpa, the site headquarters 60 km from Ranchi. The NHPC has spent Rs 4 crore on infrastructural facilities and chairman Pirzada Ghulam Nabi admits that it has all been a colossal waste of humanpower and resources. About the only breakthrough so far is that the road blockade is lifted for NHPC officials—but for no one else—whenever they undertake a periodic tour of the countryside on yet another mission of persuasion. Only 3,000 acres of the 50,000 acres have been acquired so far.

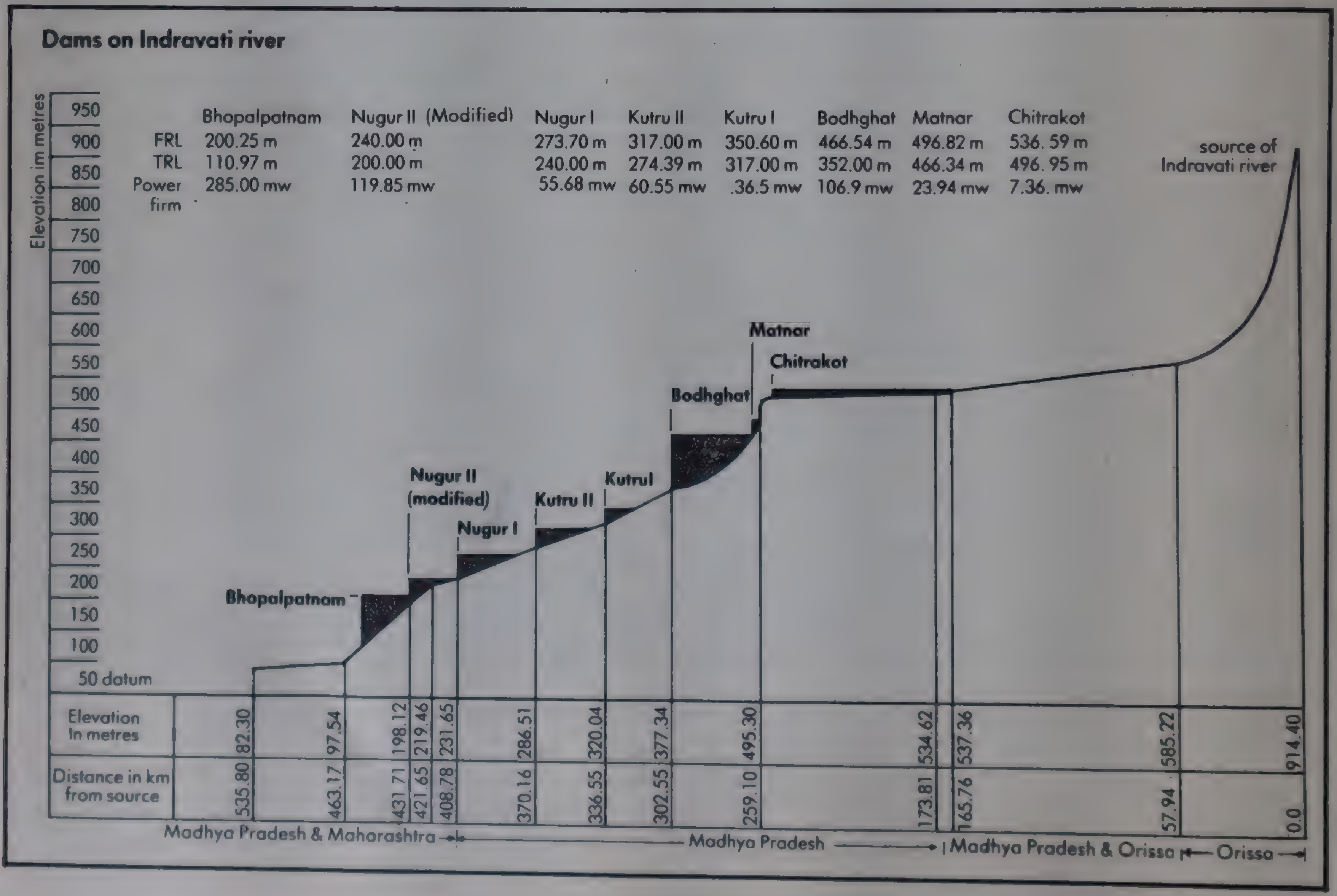
While former Chief Minister Jagannath Misra had dithered over the project, the new Chief Minister Chandra Shekhar Singh—a former energy minister at the Centre—has sent in armed constabulary to dishearten the villagers. Now rumours abound that the army will be called in and the villagers thrown out without compensation. Rumours also say that the government is offering jobs and if the tribals keep fighting, they will get neither compensation nor jobs. But people are sceptical about government promises. They point to the technical institutes, which have no machines or facilities and the first batch of students did not get jobs.

At the moment the tribals are standing firm. They insist that they do not want cash compensation but new land for the land taken away from them, a principle now accepted in law in Maharashtra and by the MP and Gujarat governments for the settlement of the people displaced by the Narmada dam. The Ranchi tribals believe that if they waver and the government somehow succeeds in starting work—with or without use of force—there will be a scramble. In the ensuing chaos, the poor will suffer, while middlemen government officials and rich farmers will once again, make a fast buck. The worst sufferers will be all those tribals who do not have any legal deeds to their land, as is common in many tribal areas.

### The battle of Bhopalpatnam – Inchampalli

Early in April 1984, a stream of adivasis made its way to Gadchiroli town in Maharashtra. There were about 5,000 of them and they assembled in Gadchiroli bazar. Then, with women in the vanguard, a procession set off for the district office. On the way, it was joined by 70-year-old Baba Amte, the healer of the woods, Lalsham Shah Maharaj, the powerful tribal leader from Madhya Pradesh, and by Sunder Lal Bahuguna, the environmentalist. The marchers presented a memorandum to the collector, which urged Mrs Gandhi to call off the projects. At the public meeting afterwards, Baba Amte spoke out forcefully against the way the government was destroying the environment with its senseless schemes.

The schemes which evoked such eye-catching criticism that overcast April day were the Inchampalli and Bhopalpatnam dams. Bhopalpatnam is a Rs 403 crore hydroelectric project to be built across the Indravati river in



**Dams on Indravati river**

| | Bhopalpatnam | Nugur II (Modified) | Nugur I | Kutru II | Kutru I | Bodhghat | Matnar | Chitrakot |
|---|---|---|---|---|---|---|---|---|
| FRL | 200.25 m | 240.00 m | 273.70 m | 317.00 m | 350.60 m | 466.54 m | 496.82 m | 536. 59 m |
| TRL | 110.97 m | 200.00 m | 240.00 m | 274.39 m | 317.00 m | 352.00 m | 466.34 m | 496. 95 m |
| Power firm | 285.00 mw | 119.85 mw | 55.68 mw | 60.55 mw | .36.5 mw | 106.9 mw | 23.94 mw | 7.36. mw |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Elevation In metres | 82.30 | 97.54 | 198.12 | 219.46 | 231.65 | 286.51 | 320.04 | 377.34 | 495.30 | 534.62 | 537.36 | 585.22 | 914.40 |
| Distance in km from source | 535.80 | 463.17 | 431.71 | 421.65 | 408.78 | 370.16 | 336.55 | 302.55 | 259.10 | 173.81 | 165.76 | 57.94 | 0.0 |

Sironcha tehsil of Maharashtra. The eastern part of the 670 ft dam falls in Maharashtra and the western part in Madhya Pradesh—its huge tribal belt of Bastar, to be exact. The cost of the project and the power generated—the installed capacity is 1,000 mw—will be shared by Maharashtra and Madhya Pradesh in a 45:55 ratio. Bhopalpatnam's water will drive the Rs 362 crore Inchampalli project's turbines, capable of generating 660 mw. The project is being sponsored jointly by Andhra Pradesh, Madhya Pradesh and Maharashtra. The Inchampalli dam is on the Godavari river.

The two projects taken together will drown nearly 172,000 hectares of forests—about 40,000 hectares of it prime mixed and deciduous jungle with teak, shisham, bamboo and many other magnificent trees. The damming of the Indravati and the Godavari will take a heavy toll of wild animals such as mouse-deer, giant squirrel, tiger, panther, bison, sambhar, cheetal, blue bull, sloth bears, black buck, wild dogs and wild buffaloes. On the Bastar side of the Bhopalpatnam project is the Kutru National Park, which has recently been upgraded to Project Tiger status, and is the only habitat of the wild buffalo in the country, apart from the Northeast.

Forest departments have deliberately undervalued the forest loss to Rs 8.56 crore, while Colonel B.L. Verma of AFPRO, using the Maharashtra forest department's own norms, puts it at a minimum of Rs 2,850 crore. In addition, the dams will destroy nearly 200 villages, displacing over 75,000 people, 40,000 of them the Madia Gond tribals who live off the sale of tendu leaves which are made into bidis. The government intends to shift them elsewhere, most probably to a Marathi speaking region, disregarding the fact that the tribals speak little Marathi. Moreover, uprooted from the forest that is the basis of their lifestyle, they are more than likely to have a tough time, as is the experience in other major projects in Bihar and Madhya Pradesh. Baba Amte calls this forced displacement "cultural ethnocide."

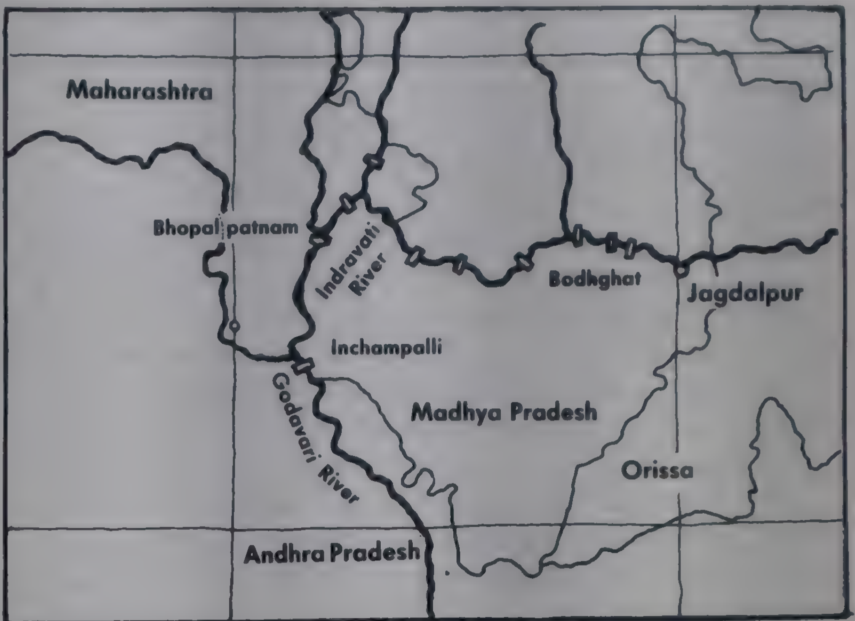
It is not as if the authorities do not know of the destruction that massive projects can cause. Undivided Chandrapur district—now split into Chandrapur and Gadchiroli—had 58 per cent of its area under forest, about 22 per cent of Maharashtra's total green cover. Over the years, the Bhandak defence project has gobbled up 2,520 hectares, refugees from East Bengal displaced 8,500 hectares, and industry, notably the Ballarpur Paper Mill, has wreaked havoc. The Ballarpur Paper Mill's insatiable demand has robbed the area of its bamboo: the factory obtains it for about 3 paise a reed, while the tribals have to pay a rupee in the market.

In July 1983, Baba Amte wrote a letter to the Prime Minister, spelling out the problem and asking for three things to be done: an interim stoppage of work on the projects; a national policy statement clarifying priorities in human, social and ecological terms in the context of economic development; and an investigation into alternative means and methods of supply of water and energy for the region.

Amte also pointed out in the letter that the area to be submerged has rich coal deposits in the Pranhita valley, which could be tapped for thermal power. He added: "It might not be necessary to incur the multiple costs and risks in building more dams of gigantic size. A series of smaller dams could adequately meet the water and energy needs of the people, including energy for industry, without degrading the environment."

"My own views are well known," replied the Prime Minister. "But it is a very difficult battle. We shall pursue the matter. I am asking the Planning Commission to look very carefully into the aspects you have mentioned." The only decision the government has taken so far is to postpone the final decision on the dam to the seventh plan—and that respite has been gained only because of the shortage of funds.

**Dams on the Indravati Sub-Basin**



Besides Baba Amte and his sons, other leaders who have rallied against the two dams include local MP Shantaram Potdukhe of the Congress (I)—he is also the president of the Vidarbha Vikas Mahasabha—and the Sironcha Taluk Panchayat Samiti's chairperson R.L. Dudiwar. The samiti stands to lose their land to these projects and has passed a resolution against them. Even a powerful state leader like Nasikrao Tirpude, former forest minister and deputy chief minister feels that the projects should be reconsidered. He points out that the Forest Conservation Act of 1980 was not in existence when these two projects were conceived of as part of the pact for sharing the waters of the Godavari.

Amte is determined, if necessary, to launch a Chipko-style non-violent movement. He is heartened by the unanimous resolution he was instrumental in getting passed by the Chandrapur-Ballarpur Regional Planning Board in September 1982, which specifically stated: "Inchampalli and Bhopalpatnam, to be commissioned out of land of the district, should not be undertaken in the overall development interests of this region, particularly due to the colossal loss of rich forest, resulting in the cultural ethnocide of the Madia tribals." This was signed by, among others, the collectors of Chandrapur and Gadchiroli. Observes Amte: "This shows that government officers have not abandoned their conscience."

Apart from the loss, the benefits from the schemes may turn out to be illusory. Although Maharashtra's share of Bhopalpatnam's power is technically 450 mw, it will actually get only 285 mw. Similarly, Inchampalli's largesse will be more in terms of irrigation than power, raising the incomes of the rich tobacco farmers in Andhra Pradesh even as invaluable teak and deciduous forests are slaughtered in Maharashtra and Madhya Pradesh.

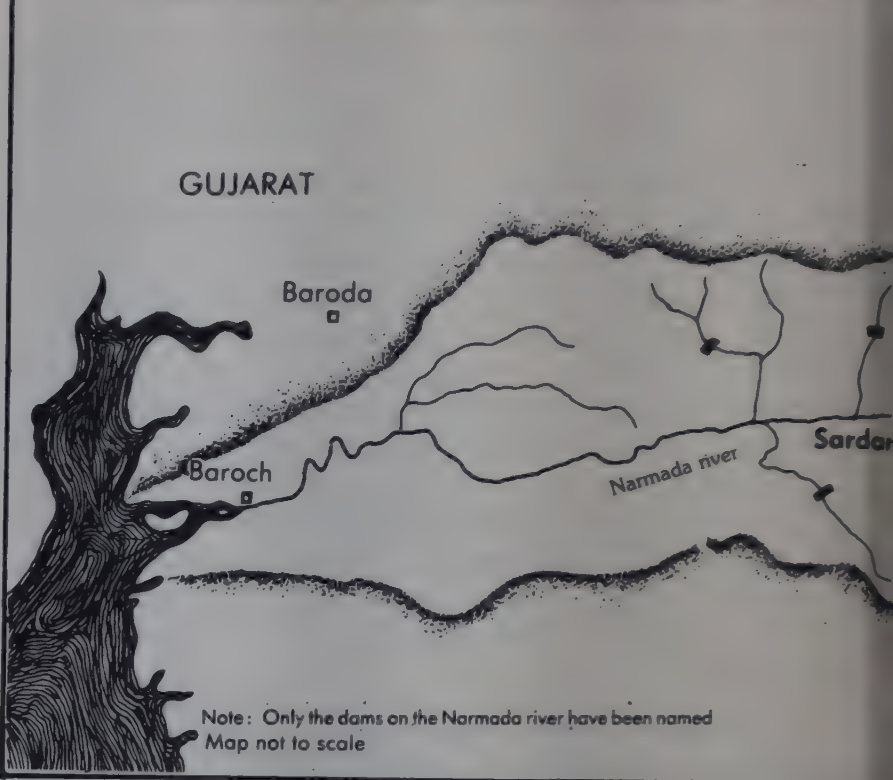
Ultimately, the issue is one of transfer of energy from rural areas to urban, bleeding the country for its cities. As in the case of Silent Valley, a virtually irreplaceable natural resource is sought to be sacrificed to provide power and water to the urban consumer, besides ignoring the tribals. This inhuman bias is the real enemy in the battle of Inchampalli-Bhopalpatnam and it remains to be seen if Amte, Lalsham Shah, Bahuguna and 75,000 tribals—and their campaign in the name of 'Manav Bachao, Jungle Bachao' (Save People, Save Forests) can overturn it.

**The Colossus of Narmada**

As plans go, this one is several times ambitious. Over the next few decades or so, the Narmada Basin Development Programme is to tame the Narmada, the largest west-flowing river in India, and its various tributaries with 329 large dams, 450 medium-sized projects and several thousand minor structures. The projected benefits are enormous: several million hectares of land irrigated; water supply to thousands of industries and households; several thousand megawatts of power; and a near-total 'economic transformation' of the penurious state of Madhya Pradesh. All this at a cost currently estimated at Rs 4000 crore but which is likely to touch an incredible Rs 25,000 crore by the time the projects are completed well into the next century.

The Narmada rises from a holy tank in the midst of a cluster of temples on the Amarkantak plateau in Shahdol district, and travels 1,300 km draining 9.88 million hectares between the Vindhya and Satpura ranges. This vast basin—the average annual flow of the river is 41 billion cum, greater than that of the Ravi, the Beas and the Sutlej combined—is largely untapped because of inter-state water disputes. Only one major project, Barna, has been completed and another at Tawa is nearing completion.

**Major Dams in the Narmada River Valley Project**



Note: Only the dams on the Narmada river have been named
Map not to scale

With no detailed assessment yet of the environmental and human problems this massive damming of the river could create, the programme could very well be a blueprint for disaster. The Narmada, unlike the snow-fed rivers of the north, depends on forests to collect the rainwater which feeds its flow. At the moment, the basin is one of the most densely forested in India but a study group of the Hindu College Nature Club has found that deforestation is already leaving ugly gashes in the greenery.

The massive Nepa Newsprint Mill, which turns out 15 per cent of India's newsprint needs, and the Orient Paper Mill have wreaked havoc in the bamboo amd hardwood resources of the area. Orient now gets its bamboo from Assam. Another menace is mining and the roads, ropeways and housing colonies that go with the mines. For instance, 1,052 hectares of land has been leased to BALCO of which only 80 hectares will actually be mined.

The strain of industrial demands will be added to the colossal trauma of submergence, which is expected to claim 3.75 lakh hectares, destroying some of India's best deciduous forests of teak and bamboo. This is only the immediate damage; the ecological instability cannot be quantified. The authorities do not seem to be bothered about this: the afforestation grant in the Narmada Sagar Project Report, for a dam expected to drown 85,000 hectares of forest, is a measly Rs 60 lakh, enough for 3,000 hectares.

The authorities are not bothered about quite a few other things. Wildlife, of which there is a rich variety in the basin, is supposed to relocate itself, that is, move out of the submergence area on its own, which means that only the most alert animals will survive. Rare wild flora, of course, could not relocate itself. About 80,000 hectares of rich cultivable land will go under, and farmers may not find as productive a substitute elsewhere.

There is also the problem of fodder to replace that from the thousands of hectares of grazing lands lost. The government has given no thought to this problem. Temples are also among the victims. The Sardar Sarovar dam will

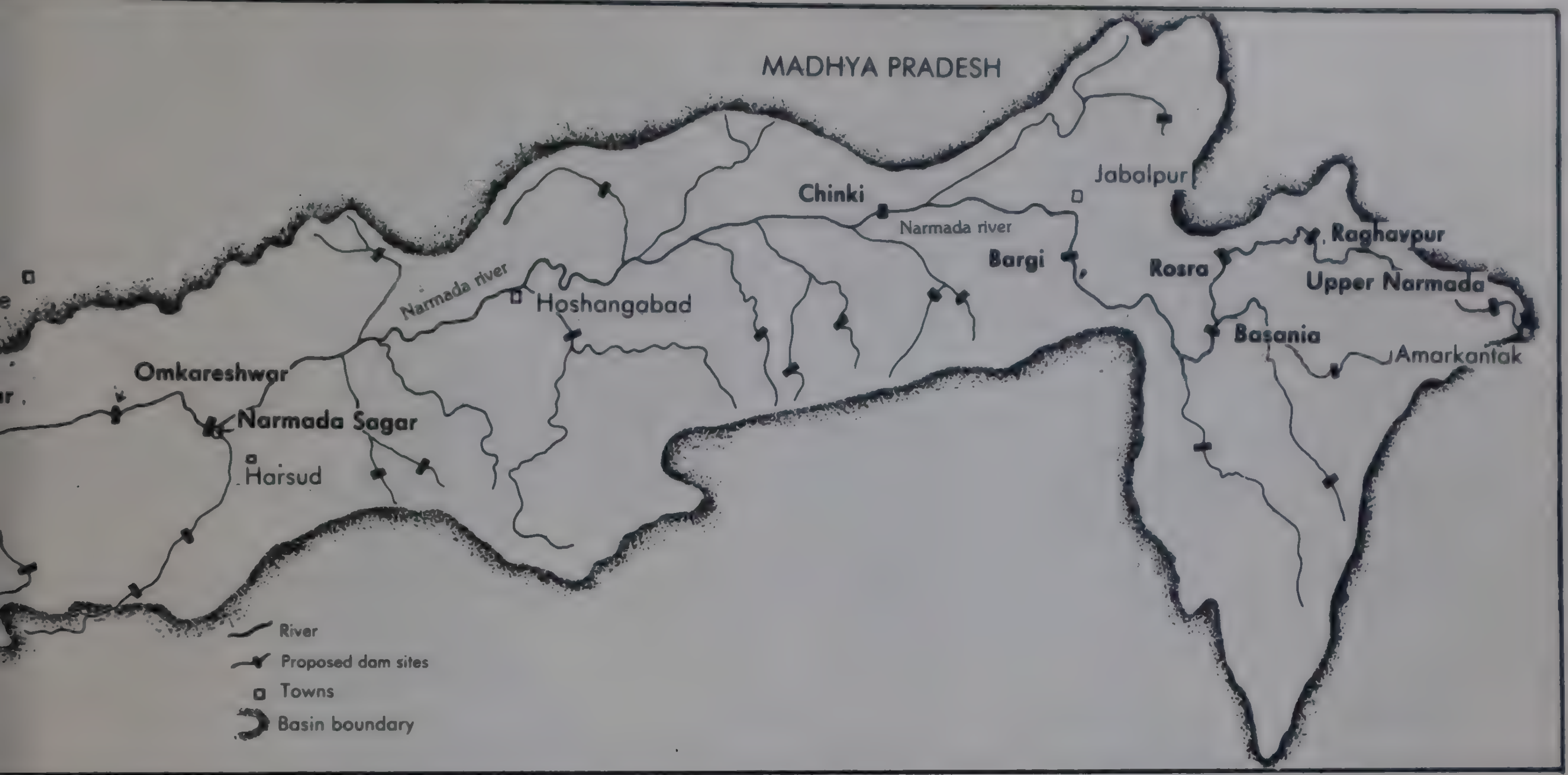
**Who Needs More Dams ?**

Criticism of India's surface irrigation schemes has come from the Planning Commission which is busy preparing the Seventh Five Year Plan. In a review released to the press in late 1983, the Planning Commission concluded that the stress in irrigation planning should move away from new projects to better management of existing projects to bridge the gap between the potential created and its utilisation. Command area development had to be given high priority.

In 1983, Irrigation Minister R.N. Mirdha told Parliament that of the 205 major and 916 medium irrigated projects taken up since the beginning of the five year plans in 1951, as many as 176 major and 447 medium projects have not been completed. As many as 13 major projects out of 25 taken up during the first plan (1951-56) are yet to be completed. Thirty-two major projects have shown cost overruns of 500 per cent or more. Since 1951, no irrigation or hydroelectric project has been completed on time and within the cost estimates. As a result, the shortfall in the irrigation potential target and actual achievement has been as big as 20 million hectares and it is now estimated that Rs 14,000 crore will be needed to bridge this gap.

States are more keen to take up new projects and spread their resources thin than take up projects that aim at lining of canals. If the productivity of irrigated lands can even reach 2.5 tonnes to 3 tonnes per hectare, not a high yield by international standards, an additional grain output of 60 million tonnes to 90 million tonnes will be easily available. As a commentator in 'The Economic Times' put it recently: "Does India need any more new irrigation projects for the next two decades for producing an estimated 215 million tonnes of foodgrains by then? Apparently not."

The Economic Times also said in an editorial: "One only hopes that both the Planning Commission and the Irrigation ministry would be able to resist pressures from chief ministers who are put to secure a pre-election bonus of a few new projects on paper. Let the seventh plan be without any new irrigation project."



submerge the important pilgrimage shrine of Suparneshwar in Gujarat as well as the Shiva temple at Rajghat near Barwani in Madhya Pradesh. The colossal Narmada Sagar dam near Punasa in Uttar Pradesh will inundate the 500-year-old fort of Joga.

Narmada Sagar, in fact, is a perfect example of the price that has to be paid for 'prosperity'. Its reservoir will spread over 910 sq km and will submerge over 40,000 hectares of agricultural land. Some 1.2 lakh people in 326 villages (including the tehsil town of Harsud in Khandwa district) will be displaced—compensation for them will amount to Rs 200 crore—as will 32 km of rail track whose relocation will cost over Rs 65 crore. Currently, the dam is expected to cost Rs 920 crore, which is already 50 per cent above the original estimate.

The biggest victims will be tribals. Large tribal populations of Bhils, Bhiladas, Gonds, Korkus, Kirs and Bhaiyas live in the Narmada valley and the projects will completely destroy their lifestyles—cultural annihilation – or make them even more dependent on the remaining forests: further ecological destruction.

For the million people who will be displaced by the projects the future is bleak. The Narmada Water Disputes Tribunal has directed that each landowning family which loses at least 25 per cent of its land is to be allotted as much land as is lost with a minimum of 2 hectares. But the land for land policy does not always work and, in Gujarat—where rehabilitation work has begun—it has been one continuous headache for the oustees: inadequate compensation, dispersal of tribal communities over several villages, and the fact that compensation is given for only the land actually lost, even though the entire farm may have to be shifted. This when several voluntary agencies have supervised the rehabilitation operations and campaigned repeatedly on behalf of the oustees. In most situations, such committed voluntary agencies do not exist.

But for the elite who work on the dam sites the sky seems to be the limit. The lavishly designed colony for the 5,000 employees of the Sardar Sarovar dam cost Rs 33 crore, which is more than what has been allotted for the permanent settlement of 30,000 people displaced by the dam. The authorities have little idea of what to do with the facilities once the dam is completed. The colony of the Tawa dam in Hoshangabad, now nearly complete, was built for 10,000 people though today only 2,000 occupy it.

With all this irrevocable disruption, are the projects worth it? There are serious doubts about the effectiveness of irrigation projects in high rainfall areas. In the deep clay soils of the middle zone of the Narmada basin—57 per cent of its total area – poor drainage and waterlogging pose such serious cultivation problems during the monsoon that the kharif crop accounts for just a third of the total cultivated area. Both the Barna and Tawa projects have increased the waterlogging menace.

The problems in the Tawa command area were anticipated in the early 1970's before much of the canal system was built. But drainage was ignored and waterlogging spread rapidly. The inept manner in which the Tawa project has been handled generates little confidence in government agencies to manage future projects. The planners appear to have learnt little from the Tawa experience: at Sardar Sarovar, just Rs 4 crore has been allocated to drainage.

Deforestation, soil erosion, siltation, pollution, wildlife destruction, cultural ethnocide—all these are the inevitable cost of the thousands of megawatts of electricity and the millions of hectares of irrigated land that the Narmada project promises. In the long run, environmental chaos is bound to reverse temporary gains. The Department of Environment is yet to clear the project—perhaps fearing that if it does, there might be no environment left for it to oversee. Clearance is being sought for each dam separately. But the combined effect of the entire scheme is likely to be far greater.

# ATMOSPHERE

*The world's worst air pollution problem could be the woodsmoke inhaled by poor rural women while cooking. A tonne of particulates from household woodstoves may actually lead to more than 500 times the human exposure than a tonne of particulates from a coalfired power station.*

*A study in Gujarat shows that women while cooking inhale 40 times the volume of suspended particles considered safe by WHO. In barely three hours they inhale an amount of carcinogenic benzo(a)pyrene that equals 20 packs of cigarettes, more than any industrial worker will be exposed to in any industry in eight working hours.*

*Exposure during the monsoon, when people reduce the ventilation points in their homes, can be eight times the normal.*

*As wood becomes scarce, women turn to cowdung, which generates even more pollution. Many new cooking fuels like crop wastes and weeds have never been tested for pollution hazard.*

*A 15-year study in Delhi found the same incidence of cor pulmonale (enlargement of the heart) in both men and women, even though few women smoke, and concluded this to be the result of women's exposure to woodsmoke.*

*In a mountain village in Nepal researchers found an amazingly high infant mortality rate of 490 per thousand—almost every second child born died. Two out of three deaths were due to respiratory diseases.*

*Exposure to woodsmoke is particularly harmful for malnourished, anaemic women as carbon monoxide, an important component of woodsmoke, increases the effect of anaemia by reducing the haemoglobin available in the blood. Over a quarter of Indian women in the reproductive age group are anaemic.*

*Environmental air pollution is also increasing steadily. In 15 years, the quantity of sulphur dioxide released into the air has tripled. Acid rain, the scourge of forests and lakes in Europe and North America, is now found in industrialised areas, Bombay, Delhi, Pune.*

*Of the 48 thermal power stations officially surveyed in 1984, 31 had taken no pollution control measures and only six had their pollution control equipment functioning properly.*

*Giant superthermal power stations is the latest policy. At Singrauli, where over 10,000 mw of power generation capacity is to be ultimately sited, the million-odd people who will live there could be exposed to 10 times the pollution levels set by the government.*

*The current car and two-wheeler boom in Indian cities could choke thousands to death. Delhi's half-a-million motor vehicles spew 400 tonnes of pollutants daily. In Bombay, a municipal survey shows that air pollution is a major cause of tuberculosis and various respiratory ailments.*

Atmospheric pollution has for long been regarded as probably the least important of all the environmental problems in the country, concentrated mainly in the major cities and industrial towns. But latest evidence shows that air pollution within homes may be an acute problem, an underlying cause of millions of deaths every year. The burning of cooking fuel envelopes the indoor environment with heavy smoke and women who have to do all the cooking may be daily exposed to more pollutants than even industrial workers in extremely polluted environments on extremely polluted days. Thus, women are being affected at every end of the cooking cycle: as firewood becomes scarce they have to put in more energy to collect fuel and then they have to face the dangers of wood smoke every day. Reducing indoor air pollution in poor homes is, thus, a most urgent environmental task today, a subject that should be of concern not only to environmentalists but also health workers. But even as the news of pollution on the home front becomes disturbing, the trends in general environmental pollution are nothing to be happy about either. The government's decision to set up giant thermal power stations to meet the country's electricity shortage is being implemented with relative efficiency. But the need to control pollution and plan for a clean environment for the human settlements coming up around these stations has yet to be felt seriously by the authorities. Agencies multiply but lack of coordination and a will to take effective steps, marks every one of them. The result is massive environmental destruction for miles around and the growing threat of acid rain in a 'developing' country.

# DOMESTIC POLLUTION

For thousands of years, people have cooked using firewood and cowdung. Even today, over 90 per cent of households use wood, dung and crop residues as fuels. Smoke-filled huts are a common sight across the countryside. During winter, when a temperature inversion prevents the smoke from rising, entire villages look as if they have been teargassed.

In developed countries, most people have given up cooking on wood or other renewable biomass resources like dung and crop wastes. But since the late 1960s, partly because of environmental concerns and partly because of the rising cost of conventional fossil fuels, there has been a resurgence of interest in the use of firewood, especially for heating homes. In the US, the use of wood had been falling since the turn of the century but began to rise in the mid–1960s at a rate of about one per cent per year and between 1975 and 1981, after the oil crisis, it grew at an annual average of almost 7 per cent.

With growing use of wood, environment protection agencies in developed countries commissioned a number of studies to assess the impact of firewood use on air pollution. These studies revealed that biomass fuels, particularly in small-scale combustion as in residential stoves, emit several important pollutants in high quantities compared to gas, oil, and even coal—the most polluting fossil fuel. As a result, many communities are now thinking of limiting firewood use. The Tennessee Valley Authority in the US, for example, which had subsidised wood-fired stoves, has announced a density limit for stoves in its region of 240 per square km. Parts of New Zealand and Europe are facing similar options.

Estimates have shown that firewood use per unit area is highest in semiurban areas in the US. In such areas, it has become necessary not only to limit the introduction of new stoves but also to mandate the use of specially designed, cleaner burning stoves or, perhaps, even the catalytic converters newly developed for wood-fired stoves. Using the same principle used for emission control in cars, a company in the US has developed catalytic converters which can be used in a high-emission wood stove. The device catalytically oxidises the products of incomplete combustion and not only reduces emission but also increases energy availability. In a number of countries, scientists and environment protection agencies are also working to develop emission efficiency standards for wood-fired stoves.

The concern in developed countries is generally about outdoor air quality, that is, general air pollution. Nearly all residential stoves are designed for space heating in the house, not for cooking, and they all incorporate a system that takes waste gases outside the house. Studies show that even then, the air quality within homes can be adversely affected by wood-fired heating stoves.

## Smoke in houses

But what about homes in a country like India where cooking is commonly done on open and inefficient chulhas with few arrangements to take the smoke out of the house? "When compared to the thousands of person-years of effort and billions of dollars that have gone into studying and attempting to relieve the air pollution problems of developed countries and cities everywhere (including the Third World), the minuscule efforts so far expended to understand this problem faced by cooks, the second largest occupation in the world (next only to agriculture), is an example of how rural women in developing countries are forgotten .... No major group is lower on the global totem pole," say Jamuna Ramakrishna and Kirk Smith of the East-West Centre at Hawaii, in a paper on smoke from cooking fires.

Recognising this major gap Kirk Smith, A.L. Aggarwal from the National Institute of Occupational Health (NIOH), Ahmedabad and R.M. Dave of the Jyoti Solar Energy Institute at Vallabh Vidyalaya decided to carry out a pilot study in four villages of Gujarat. The study was carried out in late 1981 in 36 households in Anand district, about 90 km south of Ahmedabad. The woman cook in each household was asked to wear a sophisticated air sampler which was clamped to the collar, so that the measurement device could move around with the cook and measure her actual exposure. Exposures to two major pollutants of wood smoke, total suspended particulates (TSP) and benzo(a)pyrene (BaP) were measured.

### Shocking results

The results were shocking. The average exposure of women to TSP in their cooking period ranged from 1,110 to as high as 56,600 and averaged about 7000 microgrammes per cubic metre ($\mu$g/cum), as compared to 260 $\mu$g/cum (for 24 hours) recommended in the US and 120 $\mu$mg/cum to 150 $\mu$mg/cum recommended by WHO. The proposed eight-hour Indian standard for industrial areas is 500 $\mu$g/cum and 0.1 $\mu$g/cum for sensitive areas. Concentrations of TSP are less relevant than concentrations of particles which have sizes that can be inhaled—less than three millionths of a metre.

**Estimated annual doses of respirable suspended particulates (milligrammes per individuals)**

| | |
|---|---|
| Gujarati villages | |
| Cook | 21,000 |
| Non-cook | 3,700 |
| Traffice Police in Ahmedabad | 2,600 |
| Ahmedabad city | 2,100 |
| Delhi | 1,400 |
| Bombay | 1,100 |
| WHO recommended level | 210 |

Source: Kirk Smith, East West Centre

**Estimated annual doses of Benzo(a)pyrene (microgrammes per individuals)**

| | |
|---|---|
| Gujarati Villages (Cooking only) | 4,200 |
| Ahmedabad Kitchens (cooking only) | 6,100 |
| Traffic Police station, Ahmedabad | 480 |
| Ahmedabad city (polluted areas) | 180 |
| Proposed USSR ambient standard | 3.5 |

Source: Kirk Smith, East West Centre

**Concentrations of total suspended particulates in the air of Gujarati kitchens using biomass fuels (milligrammes per cubic metre breathed in)**

| | |
|---|---|
| **Rural indoor pollution** | |
| Boria Village | |
| Morning | 4.8 |
| Evening | 8.2 |
| Denapur Village | |
| Morning | 2.7 |
| Evening | 4.3 |
| Rampura Village | |
| Morning | 6.2 |
| Evening | 5.6 |
| Meghva Village | |
| Morning | 4.9 |
| Evening | 10.0 |
| Monsoon conditions (ventilation hole in kitchen ceiling closed) | 56.6 |
| Use of two-mouth Chulha | 14.0 |
| **Kitchens in urban Ahmedabad** | |
| Those using wood | 7.2 |
| Those using cowdung | 16.0 |
| Those using wood and cowdung | 21.2 |
| **Major air pollution episode** | |
| London , 1954 (continuous for 24 hours) | 4.5 |
| **Some TSP standards** | |
| USA (for annual regular exposure) | .075 |
| USA (for 24-hour exposure) | .260 |
| WHO (for annual regular exposure) | .04—.06 |
| WHO (for 24-hour exposure) | .12—.15 |

Source: Kirk Smith, A.L. Aggarwal and R.M. Dave

Unfortunately, biomass smoke is nearly all respirable.

The infamous London smog episode of 1954, which resulted in an 80 per cent increase in mortality for a few days mainly among the already ill and is regarded as one of the worst air pollution episodes, was caused by TSP level that was similar to those experienced daily in the Gujarat kitchens. Though it must be pointed out that smog was not caused by exactly the same set of pollutants and the exposure remained continuously high for several days. In the rural kitchens of Gujarat the exposure remained high for only the cooking period, about three hours or 10 per cent of the day. But in several parts of the country, daily cooking periods are as high as six hours, or 20 per cent of the day. And there is no doubt that women are being routinely exposed to levels that are tens of times higher than recommended limits.

Measurement of BaP was equally shocking: an average of 3,850 nanogrammes per cubic metre (ng/cum). BaP has been suggested as a carcinogen in cigarette smoke. The average exposures in three hours in Gujarati homes were equivalent to smoking roughly 20 packs of cigarettes per day in terms of BaP (20 nanogrammes per cigarette). There are no national standards for BaP in any country. But the USSR has proposed an annual average standard of one ng/cum, which corresponds to an hourly average of about 6 ng/cum. The production of compounds like BaP is directly related to the size of the volatile fraction in the fuel. Unfortunately, in most biomass fuels, the volatile fraction is 60 per cent to 80 per cent of the fuel.

These estimates show that both the doses and concentrations being experienced in village homes burning biomass fuels are extremely high by global standards. They show that cooks receive a larger total dose than a resident of the dirtiest urban environment, and receive a much higher dose than the WHO's recommended level or any national public standards. Hardly any industrial worker would receive BaP doses approaching the levels found in the Gujarat study.

A number of factors make the level of exposure to pollutants worse. Dwellings in villages are small and badly ventilated. But in one of the Gujarat households, when the holes in the roof were closed, as is done regularly in monsoon conditions, ventilation was so reduced that it became impossible for the researchers to remain in the kitchen for more than a few seconds because of the discomfort caused by heavy smoke. The woman cook, however, stated that such conditions were normal during the monsoon. The exposures increased manifold and were among the highest recorded anywhere in the world.

Many households also had stoves with more than one mouth. Two mouths are used when a meal has to be prepared quickly or when cooked for a larger number of persons. When a woman cooked on a stove with two mouths, exposures to TSP approximately doubled over one mouth conditions. Exposures were found to be smaller but still high even in the room adjacent to the kitchen. In other words, even the non-cooking members of the family were being exposed to high levels of pollutants.

Studies conducted by the (NIOH) in 16 urban households in Ahmedabad using biomass fuels have also shown high levels of TSP and BaP. Concentrations increased when dung was added to or used instead of wood. TSP ranged from 4,700 µg/cum to 58,600 µg/cum and BaP up to 26,000 µg/cum.

Climate will also play an important role in increasing exposures. During the winter, and especially up in the mountains, wood is not just burnt for cooking but also for space heating. In the hills, space heating is done in small, closed houses with poor ventilation to keep the heat in. In such situations, exposure to wood smoke would be very high and would add to the wood smoke exposure for cooking.

**Daily exposure to particulates in Gujarat villages (milligrammes — hour per cubic metre of air breathed in)**

| | Cooks | Others |
|---|---|---|
| Dry season | 19 | 6.0 |
| Monsoon | 160 | 3.0 |

Source: Kirk Smith, East West Centre

Thus twice a year concentrations are even higher than at other times. One is during winter, when ground level inversions are common in north India and the other during the monsoon, when whatever openings that might exist in the ceiling are closed.

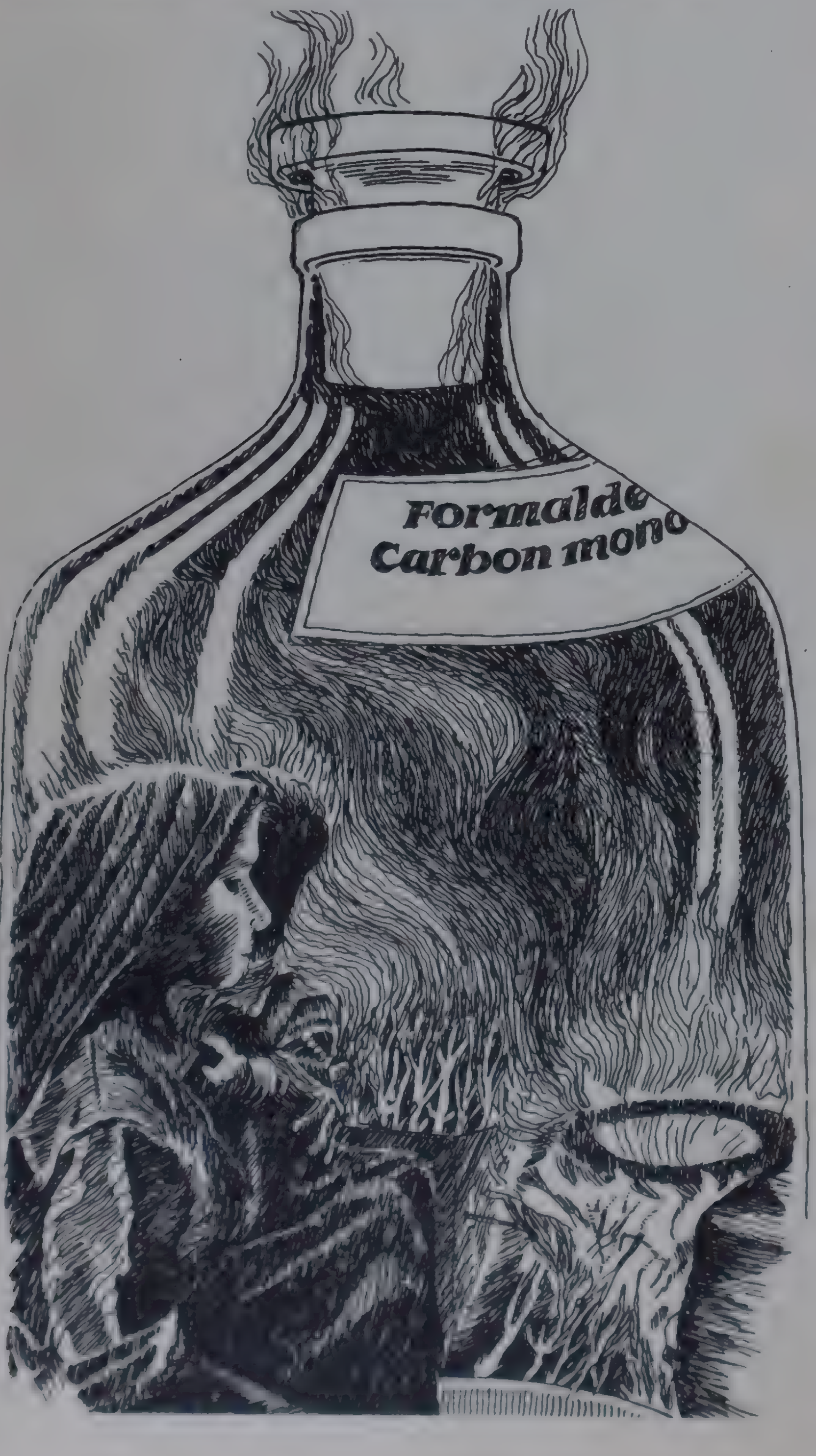
### Health of women

What does this mean for the health of women who cook? The most powerful evidence for the ill-effects of wood smoke comes from a survey of a heart disease called cor pulmonale, in which the right lower chamber of the heart enlarges and fails because of a disorder in the lungs. The survey was carried out over a period of 15 years on hospital patients in Delhi.

It found that there was a surprising similarity in the incidence of cor pulmonale between men and women even though 75 per cent of men were smokers of tobacco as compared to 10 per cent of women. Cor pulmonale in developed countries has generally followed smoking patterns, being more in men. In addition, the age of onset of cor pulmonale in Delhi was much lower for women. Bronchitis and emphysema—abnormal distension of the lungs with air—were the main lung diseases diagnosed in both sexes.

Nearly all the women were from the lowest income group. While all the women patients cooked, only 7 per cent of the men claimed that they cooked. The cooking fuels used were mainly of dung (63 per cent), wood (25 per cent) and coal (12 per cent).

The authors, Dr S. Padmavati and Dr S. Arora concluded: "Cigarette smoking is prevalent all over India and must be a contributory cause of bronchitis in men, but not in women, as only 10 per cent of them smoke cigarettes. The women are, however, exposed to smoky primitive fireplaces from childhood. They gave a shorter history of cough and expectoration (coughing up fluid from lungs and air passages); the onset of cor pulmonale was 10 to 15 years earlier and they showed more severe congestive heart failure, greater cardiac (heart) enlargements and greater derangement of pulmonary (lung) function with a severe loss of exercise tolerance ..... From this study it appears that in Delhi, domestic air pollution is probably the cause of the higher prevalence of cor pulmonale in women than in men and the early exposure of the younger age of onset."



Padmavati and Arora argued that the lower incidence of cor pulmonale in south India as compared to Delhi may be due to generally better ventilated cooking areas.

The Gujarat study notes that women in the four villages studied had begun to learn cooking at the average age of 13. Many younger girls would get exposed to smoke sitting by their mother. In Ahmedabad, another study of the incidence of cough, cough with expectoration, dyspnoea (difficulty in breathing) and lung abnormalities found a statistically higher incidence among women cooking with smoky fuels.

Studies in Nepal have shown a strong association of domestic smoke with chronic bronchitis. A survey was carried out in Jumla, a cold remote mountain district at 2,300 metres, where climate and housing conditions are such that indoor smoke levels are noticeably higher than those in households of the mid-hill regions. The smoke inside the houses is concentrated enough to cause the skin and clothes of the inhabitants to become black with soot. A distressingly high incidence of acute respiratory infection (ARI) was found and was the most important cause of mortality and morbidity among infants below one year in age. Total infant mortality was about 490 per thousand and of these about 333 were due to ARI. Such mortality rates are among the world's highest and it is not difficult to believe that the high prevalence of infant and childhood ARI is due partially to the irritation caused by such indoor, smoke filled conditions. Such conditions could also prevail in Indian Himalayan villages.

Though biomass smoke is a complicated mixture of thousands of pollutants, and its impact may be more than the sum of the impact of individual pollutants, indirect evidence of the ill-effects of smoke can also be gathered from studies that have been done on individual pollutants. Other than particulates and compounds like BaP, two major pollutants in biomass smoke are carbon monoxide (CO) and formaldehyde (HCHO).

### Anaemic women

Carbon monoxide is a colourless and odourless gas which is highly toxic if inhaled in sufficient quantities. Haemoglobin, the oxygen-carrying substance in blood, has a much greater affinity for carbon monoxide than it has for oxygen; together they form a stable compound, carboxyhaemoglobin (HbCO), that decreases the amount of uncombined haemoglobin available for oxygen transport. If HbCO levels become high enough, coma and death can occur. It is generally believed that 5 per cent HbCO is an appropriate upper limit for avoiding detrimental acute effects in a large population.

Oxygen deprivation at altitude acts on the body in a similar manner as increasing HbCO. For instance, if someone is at sea level, 100 ppm CO (equal to about 11 per cent to 13 per cent) is equivalent to being at about 3,750 metres.

## Unhealthy Bombay

Tuberculosis and respiratory ailments are the biggest killers in Bombay says a Bombay Municipal Corporation survey. Between 1971 and 1979, the number of TB deaths per 100,000 people went up from 82.7 to 101.2. Although the number of deaths due to breathing impairments dropped from 169.7 to 142.6 in the same period—largely because of the use of low-sulphur gas from Bombay in the most highly polluting industries—this is still the single largest fatal hazard.

These findings are even more alarming when viewed against the fact that deaths due to infectious diseases have dropped in number while those caused by gastroenteritis have remained constant. The only other causes of death to show an appreciable increase are cardiovascular ailments which like TB and respiratory ailments, can be attributed to the city's rapidly deteriorating environment.

The corporation set up a Health Survey Unit in 1976 under Dr S.R. Kamat of the Chest Medicine Department of the KEM Hospital. Over the next seven years, it conducted exhaustive studies of the city's environment; it divided the city into three units: the central area—and easily the most polluted—the eastern and the western suburbs. A rural locality was examined for contrast.

The study clearly established that the hazards in central Bombay with its textile mills are twice that of the eastern suburbs. Central Bombay chokes on sulphur dioxide, nitrogen oxides, ozone and benzopyrene, in telling contrast to the western suburbs—Khar was the test case—which were the cleanest, a consequence both of the absence of industry as well as the cleansing effect of coastal sea breezes.

Kamat and his team have done follow-up studies on some 4,000 cases since 1977 and believe that "our data shows fairly conclusively that air pollutants are the major factor in causing widely prevalent health abnormalities. These effects are leading to a serious loss of person-workdays and imposing a very significant burden on health services in Bombay." Sulphur dioxide and nitrogen dioxide levels were highest in Lalbaug; they were responsible for frequent colds and coughs, dyspnoea, breathlessness and multiple chest symptoms. The conclusion: "Urban subjects from more polluted zones had higher abnormalities including lower and upper respiratory symptoms, chronic heart and lung diseases (bronchitis, fibrosis, cancer) with an evidence of eye, nasal and skin irritation." Cancer can be linked with benzopyrene levels, which are high in Bombay because of the large number of cars.

The survey unit also looked at general health indices like food and water contamination and nutrition and found, unsurprisingly, that environmental degradation in these spheres adversely affects the people. The living conditions of the "other half"—slum and pavement dwellers—also contributes in no small measure to ill-health.

The rising number of cardiovascular deaths is attributed to the tremendous traffic congestion in certain parts: Bombay has half the taxis in the country and a fifth of all private vehicles. The survey unit carefully studied the link between carbon monoxide pollution, caused by cars and trucks, and ischaemic heart disease in a community living at a busy road junction, Lalbaug which was chosen because it is in the heart of the central district and because, at the time of the survey, the textile mills were on strike, enabling researchers to examine the effects of vehicle exhaust alone. They found no direct causal relationship, though these exhaust contain sulphur dioxide and nitrogen dioxide, which affect breathing. Nevertheless, the survey recommended that traffic junctions should be properly designed for smooth flow and flyovers built some distance from residential buildings–a timely suggestion since the Draft Development Plan for Greater Bombay (1981-2001) talks of 23 new flyovers for the metropolis.

Studies in Guatemala show that women cooks living in villages at higher altitudes, faced with the same concentration of CO, are affected much more and have higher levels of HbCO. The impact of nearly continuous but ower exposure or daily but short-term intermediate exposure to CO is difficult to assess accurately. Dizziness, headaches, nausea and a feeling of weakness can accompany moderate short-term exposure, but it is not clear what, if any, are the long-term effects.

There is a growing body of evidence that points to a strong link between chronic CO exposures and both heart disease and impaired foetal development. Recent evidence points to a strong association of CO with heart diseases long attributed to other combustion products of cigarettes. While CO has not itself been found to be carcinogenic, there s concern that it may act to increase the carcinogenic effects of other air pollutants by inhibiting the ability of the lungs to clear themselves.

Any condition which results in reducing the blood's capability to carry oxygen to the tissues, like anaemia (a condition in which red blood cells are reduced in number or are deficient in haemoglobin, their oxygen-carrying pigment), will also make a person more susceptible to carbon monoxide toxicity. This is particularly bad for Indian women who are anaemic in large numbers. It is estimated hat in India 40 per cent to 60 per cent of pre-school children, 25 per cent to 30 per cent of women in reproductive age and almost 50 per cent of pregnant women n third trimester (more than 24 weeks of pregnancy) are anaemic. Chronic lung diseases will further reduce the capability of the blood to rid itself of carbon monoxide during periods of low or no exposure.

There are several factors that make women particularly susceptible to CO exposure. Women generally have less haemoglobin reserve than men, which makes them more prone to anaemia, which also makes them more vulnerable to lower doses of CO than men. During pregnancy there is additional demand on haemoglobin, further lowering their reserves and making them more sensitive to CO. This exposure can also affect the unborn child leading to reduced birth weight and increased perinatal death rates (that is, deaths at birth or in first week of life). A 1977 study of birth weights in Los Angeles reported a significantly negative impact of the air pollution of which CO was a major component. It is not surprising that respiratory diseases are a leading cause of death among girls and women over the age of five in India.

The impact on a pregnant, malnourished anaemic woman with chronic lung diseases who cooks in a mountain community would be the greatest, and so would be the effect on her unborn child. Imagine what the effect would be on such a woman who then has to face the added burden caused by deforestation who has to walk further and further to collect fuel and carry heavy load of this fuel back home. In the hills, even pregnant women go up steep hill slopes to collect firewood.

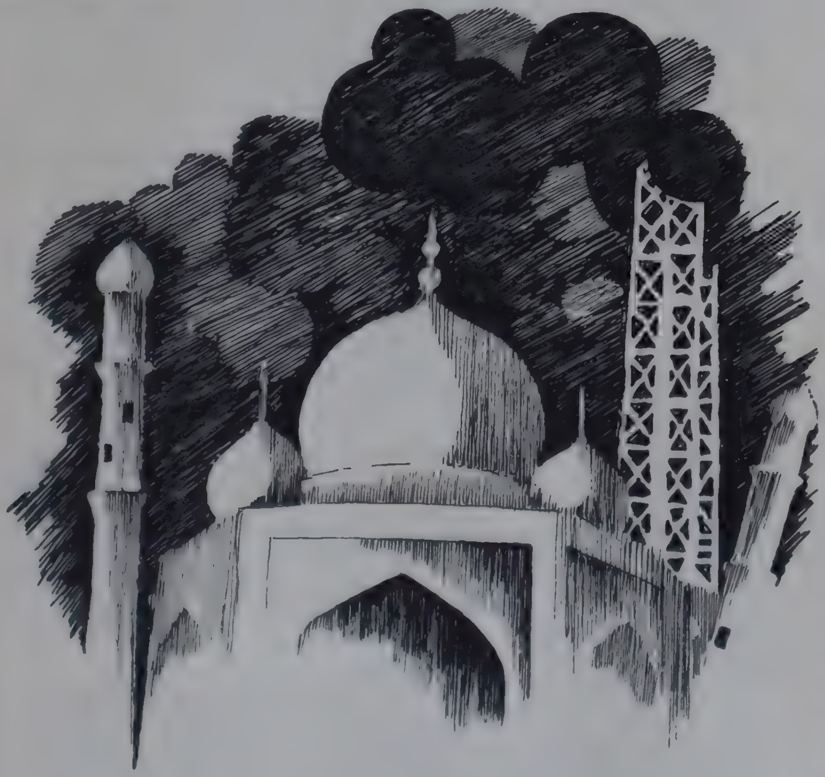
Formaldehyde is another pollutant in smoke. It causes irritation in the eyes, nose and throat and usually this irritation begins at 0.1 ppm to 1.0 ppm. Some people can become adapted to 2 ppm to 3 ppm for as long as eight hours without undue comfort. But above 5 ppm most people are extremely uncomfortable and remain so for an hour or more after the end of exposure. Formaldehyde is poisonous to tissues in the lungs and has been found to exacerbate skin wounds. It is considered a human carcinogen and there is evidence that aldehydes and BaP can act synergistically to hasten tumour growth in animals. Studies on the effects of smoking, also indicate the kind of impact that wood smoke may have on health of women. The longer the history of cigarette smoking, the higher the risk. Women begin cooking as young girls and continue for much of their lives. Young girls may receive significant exposure at their mother's sides even before the often tender age at which they begin cooking full time.

Inhalation of the cigarette smoke increases risk. In the case of cooking smoke, inhalation is inevitable because exposure to smoke comes with every breath and not as a puff once every several breaths. Exposure to cigarette smoke during pregnancy and nursing increases the risks to mother and child. Pregnant and nursing mothers generally have no option but to cook and so remain exposed to smoke.

Chronic obstructive lung diseases, heart diseases like co pulmonale, cancer (particularly lung and nasopharyngeal cancer), acute respiratory diseases resulting from the decreased ability of the lungs to clear themselves, and low birth weights of children born to mothers exposed to wood smoke and their increased perinatal mortality and

## Monumental Neglect

The Taj Mahal is easily the best-known monument in India. For years, it was also thought to be the most threatened, environmentally speaking. Today, the "miracle in marble" is the object of government attention. The National Environmental Engineering Research Institute (NEERI) regularly monitors sulphur dioxide and dust emissions caused by the oil refinery 40 km away. The refinery itself, of 6 million tonne a year capacity and fully commissioned in May 1983, uses low sulphur crude for half its requirements, and spews out 24 tonnes of sulphur dioxide daily, which should not pose a threat to the monument which lies directly downwind of the smokestack at Mathura. Two superannuated thermal power stations in Agra, are gone and coal-burning locomotives have been converted to diesel: in the town, sulphur dioxide levels are down by as much as 75 per cent.



Thus far, the recommendations of the Varadarajan Committee, which for four years studied the problem in minute detail, have been followed. But an important precaution it suggested is yet to be taken: shifting Agra's 250 small iron foundries—and their smoke belching furnaces—out of the town. The owners are influential and politically powerful. Experts are now thinking of redesigning the furnaces so that their sulphur dioxide emissions are reduced.

At one stage, the Central government actually asked the Indian Oil Corporation, which runs the Mathura refinery, to see if it could provide LPG gas to the entire town so that smoky chulhas could be put away. This move was obviously doomed from the start. The authorities have promised to establish a green belt around Agra as a buffer against refinery smoke but not a single tree has been planted so far.

On the other hand, local people are perturbed about the Central government's attempt to declare a "no-industry" zone around Agra. The state government, too wants to establish industrial estates—one close to Sikandra, where Akbar is buried, on the outskirts of the town. Obviously, the strictest vigilance will have to be maintained to make sure no environmentally dangerous factory comes up near Agra.

Unfortunately, there is no evidence that the expertise gained from the Agra experience is being put to use elsewhere in the country. Other famous monuments going the Taj way are the Red Fort, the Jama Masjid and the Qutab Minar in Delhi, the Sun Temple of Konarak in Orissa, the Gol Gumbaj in Bijapur and the Ellora caves near Aurangabad.

A number of national monuments in Delhi are very close to the Rajghat and Indraprastha power stations. The sandstone and marble of the Red Fort is turning black because of their fumes and smoke. The Archaeological Survey of India (ASI) periodically cleans parts of the fort, but no permanent solution is in sight. The cleaning agent affects the stone and is not advised for long periods. Even Rashtrapati Bhawan, built half a century ago is affected by air pollution.

Many other monuments in industrial cities are under attack from the sulphur in oil and coal. The sulphur dioxide is converted into sulphuric acid, which gets deposited on walls together with fine particles of soot. Building materials, especially those with a calcium base, are sensitive to sulphuric acid. The marble of the Victoria and Albert Memorial in Calcutta is being attacked in this manner. No comprehensive study has yet been carried out by any organisation, including the ASI, on how various pollutants damage old edifices. For instance, the Sun Temple of Konarak on the Orissa coast is affected by salt sea spray.

Human activity around such sites has hastened their decay. When these ancient cities and communities were at the height of their glory, they were protected against winds and dust storms by belts of trees and vegetation around them. But many ruins are today found in the middle of desert-like conditions with raging winds forcing millions of sand particles against the surviving walls and roofs. "Examples of these are Balbek in Lebanon, Palmyra in Syria, Hatra in Iran, Pagan in Burma and many sites in the United Arab Republic and India, too numerous to name," concludes a UNESCO report on museums and monuments. "Damage will be less serious though still noticeable, where some vegetation has survived," it adds.

As the prospects of controlling human-made environmental degradation seem to be dim, the stress in India is on periodic maintenance and repair. The National Research Laboratory for Conservation of Cultural Property in Lucknow has undertaken research to prepare better cleaning agents. The laboratory is the outcome of the government's realisation that historical monuments not only preserve the cultural heritage of a nation but also attract thousands of foreign visitors and foreign exchange.

It is seldom realised that India has the largest number of archaeological monuments in the world and also some of the most poorly protected. The ASI has 5,000 in its charge, while state governments look after twice as many, leaving 32,000 totally uncared for. In that context, saving one Taj Mahal is not as great an achievement as it is made out to be.

orbidity, are therefore, among some of the major effects at can be expected from wood smoke.

There is general agreement that the health of rural omen is significantly worse than that of the rural male opulation. A number of reasons have been presented in e past to explain this phenomenon: high fertility rates, ss access to health care, inadequate diets, and differences economic roles. Smoke exposure could also be one of the ajor factors.

The famous Khanna study carried out in 11 Punjab llages between 1953 and 1960 with a follow-up 10 years ter showed that death rates from all causes were greater r women (except tetanus, which was three times greater mong newborn males). The crude death rate was 26 per ent higher for women than men. No specific cause could e found to explain this relatively greater death rate. hildbirth accounted for only 28 per cent of the difference etween male and female death rates. There was a much gher incidence of cancer, tuberculosis and pneumonia mongst women, all of which could be related to higher xposures to wood smoke.

Data from Kaira district in Gujarat also shows that iarrhoeal and enteric diseases are prominent in both sexes the one to 15 age group. But beyond that age, respiratory fections take first place with bronchitis, emphysema and sthma attaining a prominent position among women ooner (15-44 years) than in men (45-64 years).

## vailable solutions

here are several steps that can be taken to cut down the xposures to smoke while cooking and reduce its adverse npact on health: cleaner fuels, improved stoves and better entilation. As far as cleaner fuels go one major option ould be to speed up the use of kerosene and electricity. ut the government will be unable to supply electricity in ne quantities needed for cooking. Moreover, most people re too poor to be able to purchase electricity. Kerosene is heaper but it too is used in the rural areas more for lighting han for cooking, even though it is subsidised. Kerosene is so a limited fossil resource and can only provide an interim rrangement.

Biogas is another fuel which can greatly reduce the ealth problems caused by wood smoke. Unfortunately, iogas plants, despite major government programmes, have ot spread far and wide and remain limited mainly to the cher peasant households with an adequate number of attle. Producer gas is yet another alternative. This gas is nade by controlled combustion of biomass like wood or rop residues in low-air conditions. But because of the arious problems of waste disposal associated with the rocess, few proposals have been made for residential use f producer gas.

Methanol or ethanol could also be supplied for cooking. hese clean, liquid fuels can be made from wood and crops ke sugarcane and cassava, but because these commodities re in short supply and expensive, it is very unlikely that ney will ever be used in large quantities for cooking.

### hoice of tree species

hus, there are only two options open. Firstly, those species f trees should be planted in social forestry programmes hich give off less smoke when burnt. During their study in Gujarat villages, Kirk Smith and his colleagues found that villagers distinguished different species of wood on the basis of relative smokiness. The prices of different types of wood in a nearby urban market were also found to vary between 35 paise and 25 paise per kg according to their levels of smokiness.

The villagers were using baval (*Acacia nilotica*), neem, mango and other types of wood. According to them baval was the least smoky, neem the most. Just as yield, disease resistance, fertiliser requirements and other characteristics are carefully considered for choosing a species of tree, low levels of smokiness should also be considered an important quality.

### An Industry Expands

The pollution control equipment manufacturing industry received a shot in the arm with the Air Pollution Control Act of 1982. There is as yet no detailed market survey for pollution control systems and equipment but quite a few companies have signed agreements with foreign companies for the supply of technology.

The public sector colossus, Bharat Heavy Electricals Ltd (BHEL) comfortably straddles the industry at present. It is the country's largest manufacturer of precipitators with a market potential of Rs 140 crore. Since BHEL also manufactures boilers and erects thermal power plants, clients approach it for pollution control equipment also

Flakt India—formerly S.F. India—the Indian subsidiary of the Swedish multinational Flakt AB, has a market share of Rs 8 crore for its air pollution control systems and devices. BHEL has a collaboration agreement with Flakt AB and, therefore, BHEL and Flakt India have agreed not to compete with each other in specific areas of the Indian market.

There are others in the ring. Voltas has obtained technology, mainly for precipitators, from Research Lottrell Inc of the US. Andrew Yule and Co, now a government undertaking, is also in the field with West German collaboration. The market for both Andrew Yule and Voltas may be about Rs 8 crore or more. The General Electric Co of India has also obtained West German technology while the Pune-based Thermax Private Ltd and Batliboi are in business with US technology. West Germans and Americans have emerged as major suppliers of technology for the Indian industry. According to an industry observer, the technology supplied by the Soviets for pollution control at the Visakhapatnam steel project is obsolete.

Overseas manufacturers of pollution control equipment have been eyeing the Indian market closely, and a flood of imports is likely in the coming years, partly because of the new liberal import policy for capital goods. "Such imports would hurt the indigenous engineering industry and hamper the process of self-reliance in a fast growing segment of the industry," asserts Flakt India's Managing Director Arun Thiagarajan. However, the crucial point is whether the government will choose to enforce the new act or turn a blind eye to increasing air pollution, as it has done in the case of water pollution.

A second major alternative is to increase the use of charcoal. Charcoal is produced by heating wood in the absence of air in underground or other air tight conditions, often for several weeks. As a result, the volatile content is greatly reduced leaving a low-volatility solid. Particulates and other hydrocarbon emissions are released at the charcoal manufacturing step, and thus, charcoal burns relatively cleanly at the cooking stage, except for potentially high emissions of carbon monoxide. Because formaldehyde emissions from charcoal are low, the eyes do not smart and do not warn the cook about high levels of carbon monoxide build-up. Removal of gases through a well fitted chimney will be essential if charcoal is to be used as

Smoke rising from stoves pollutes cities (A.C. Pasricha)

a major fuel for indoor cooking.

**Smokeless chulhas**

The second major solution to the problem is to so design stoves that exposure to smoke is reduced. A simple chimney can be introduced to take the smoke out of the house but this will lead to increased outdoor air pollution. In a meteorological situation, where inversion takes place over many winter months, reducing outdoor pollution is also very important. During these months, exposure to pollutants can increase substantially both for cooks and the village community as a whole.

Stoves can also be designed to improve thermal efficiency, that is, to use less fuel to do the same amount of cooking. But recent experiments also show that the steps taken to increase thermal efficiency can sometimes lead to higher rates of emission, and there can thus be a net increase in pollutant emission. In recent years, a number of groups have designed efficient chulhas to reduce the rate of deforestation. Though many of these designs include a chimney, some which are supposed to have high thermal efficiency do not incorporate any mechanism to take the smoke out of the house, such as the improved stove of the Tata Energy Research Institute (TERI) in Pondicherry or of the Central Power Research Institute (CPRI) in Bangalore. These stoves have an enclosed combustion chamber but no chimney for inducing natural drafts or removing smoke.

The increase in efficiency attained by enclosing combustion in a chamber is likely also to result in an increase in emission rates, because of improper mixing of air and volatile gases, and lowered burning rates. There is a need to design stoves that have a higher thermal efficiency, reduce the emission of pollutants and incorporate flues (smoke ducts in chimneys).

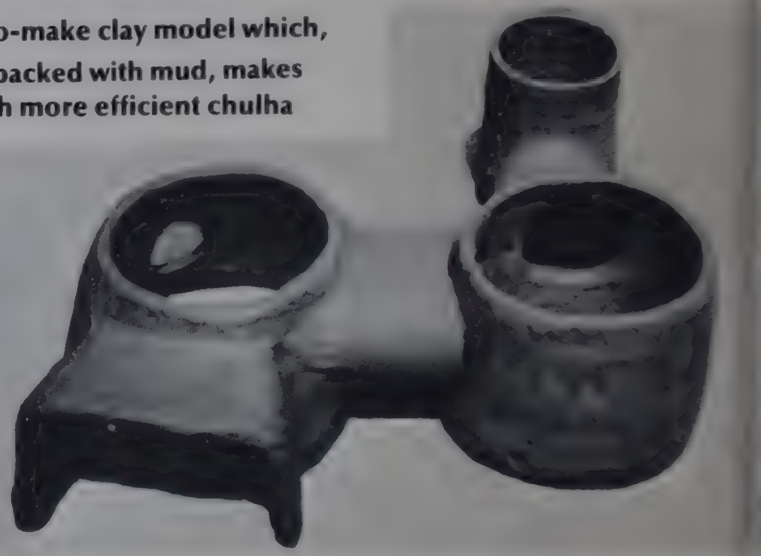
The first major effort toward improved chulhas was made in the 1950s by S.P. Raju who also wrote a famous book called 'Smokeless Kitchen for the Millions'. Raju's effort itself was inspired by an early smokeless stove design, the Hyderabad Engineering Research Laboratory's smokeless HERL chulha, developed in the 1940s. Later Gandhiniketan Ashram and the All India Village Industries Commission, building on the work of HERL, developed the Magan chulha. This chulha has three pot holes and theoretically reduces fuel use. Magan chulha can be made by hand and with entirely indigenous materials, except for the chimney.

Today in India a number of institutions are working on improved chulhas but few have been able to spread the message. The Department of Non-Conventional Sources of Energy has launched a major national programme on dissemination of improved stoves. Under the social forestry programmes aided by international agencies like the World Bank, improved stoves have been distributed by the thousands in many states.

Working first near Chandigarh in a village called Nada and later in other villages of Punjab, former architect Madhu Sarin has taken a different approach. Sarin works closely with the beneficiaries of the new technology even at the design stage. The new Nada stove, which Sarin helped to pioneer, evolved spontaneously out of the traditional stove in the village when Sarin worked closely with the stove user.

For Sarin, involvement of women in stove dissemination programmes is crucial. She argues that women seldom take decisions even about their own technological needs and the little cash that would be needed to purchase new technologies is denied to them by men. Thus, stove dissemination programmes must be undertaken in a way that they support and increase confidence of rural women. Sarin is today the most successful improved stove disseminator in India.

Easy-to-make clay model which, when packed with mud, makes a much more efficient chulha



**Large schemes criticised**

Sarin is highly critical of large stove distribution programmes because they do not involve the users and often even end up supplying defective stoves which are smoky and consume more wood than before. In Gujarat, Kirk Smith and his colleagues found that even though many families had been given so-called smokeless chulhas under the social forestry programme, their houses were still full o smoke and walls full of soot. They found that the stoves ha not been installed correctly, maintained adequately, or operated properly to reduce smoke levels by great amount Poor installation of the chimney often led to leaks in the roofs, according to householders. This, in some cases, prompted the family to cut off the chimney within the roo just under the ceiling, thereby allowing the smoke to remai in the house.

In some cases, ash or soot had not been taken out of the chimney or the chulha, preventing the exit of smoke. Forgetting to cover the second pothole when it wasn't needed for cooking allowed smoke to enter the room. Design, too, was faulty in some cases, leading to cracks in th stove. In other cases, smoke backed into the room in the slightest wind.

Some of the faults lay clearly in the design. For example, uring the initial stages of lighting the fire, before the draft ad been established, most of the smoke would enter the oom even in the best of conditions. Unfortunately, this is sually the period of highest emission rates in biomass ombustion.

However, the demand for smokeless stoves now seems be increasing. K.S. Kunjwal, a Gandhian worker from ausani in Uttar Pradesh has been trying to promote nproved stoves from the early 1950s. His first was made to elp his mother.

"We built a few of the new smokeless chulhas in the llages of Almora then, but because of lack of interest, we oon gave up the work," says Kunjwal. But now he finds that ill people even pay him for making improved stoves. Sarin lso finds a good response from women.

Both say that for women, reduction of smoke levels nside the kitchen is more important than fuel saving. .S. Jagadish of the Cell for Application of Science and echnology to Rural Areas (ASTRA) in Bangalore also finds hat women of Ungra village, where his group is working, re extremely enthusiastic about the smokeless stoves they ave been given.

### ealth or efficiency

n theory, the goals of high efficiency and low emission re not in opposition. Everything else being equal, nproved combustion efficiency would serve both needs. Unfortunately, the major technique used to improve stove hermal efficiency is to control the air flow so that the esidence time of the flue gases within the stove is ncreased. This allows for greater efficiency in the extraction f heat from these gases to the pots but this can also lead to ower combustion efficiencies and consequently, greater mission factors.

Similarly, the principal method of reducing exposure to moke is to incorporate flues, but this can often reduce nergy efficiency by creating a draft so that the residence ime is reduced. Field experience shows that it is only when lues are combined with chulhas with holes for two or more ots that similar or greater energy efficiencies are possible. n households where only one pothole is used, the addition f a flue could result in unchanged or lower thermal fficiency. Several improved stoves with one pothole have een developed in India but they still have to be tested for heir emission factors.

There are other conflicting problems as well. For nstance, less moisture in the fuel is good for thermal fficiency but reducing the moisture content beyond a point nay increase emission. The rate at which solid fuels burn is lso critical in controlling emission. At high burning rates, here is better mixing of air and volatile gases and more omplete combustion. In industrial furnaces, with a burning ate of more than 100 kg per hour, wood burns quite cleanly. But in cookstoves, to increase heat transfer to the pots and mprove thermal efficiency, the burning rate has to be ninimised.

In small fires with burning rates of a few kilogrammes per our, it is more difficult to achieve complete combustion. mission rates increase manifold in small fires. Very small decreases in the burning rate can produce very large ncreases in emission. Most cookstoves operate with urning rates around 2 kg per hour. In such conditions, there is a dramatic increase in the emission of particulates, carbon monoxide and hydrocarbons. Similarly, baffles (a device to break the flow of air) will generally improve efficiency but increase emission.

**Influence of various fuel and stove 'design' factors on emissions of pollutant and efficiency.**

| | Action that needs to be taken to | |
|---|---|---|
| **Fuel Factors** | **minimize emissions** | **maximum efficiency** |
| % Ash Content | Minimize | Minimize |
| % volatile Fraction | Minimize | Minimize |
| Surface to Volume Ratio | Minimize | Minimize |
| Size of Fuel Charge | Minimize | Minimize |
| Moisture Content | Optimize at 25% | Optimize at 5% |
| Burning or Fueling Rate | Maximize | Minimize |
| **Stove Factors** | | |
| Combustion Confinement | Minimize | Maximize |
| Temperature | Maximize | Minimize |
| Excess air | Minimize | Optimize |
| Preheated Primary Air | optimise | Maximize |

Source : Kirk Smith

The increased emission that results from dung and crop residues as compared to wood may be due to the lower temperatures reached. Most of the critical pollutants from biomass combustion are products of incomplete combustion, which is greater at lower flame temperatures. Dung burns at lower temperatures, which would lead to higher emission rates. Crop residues include such a wide variety of materials that generalisations about their being better or worse than wood are extremely difficult.

The design challenge in stoves is, therefore, to make such stoves which reduce fuel use (increase thermal efficiency ) reduce emission of pollutants, incorporate flues, can be built with local skills and materials, and with the participation of the potential beneficiaries.

Because of the shortage of wood, women are being increasingly forced to collect various new types of biomass materials like twigs and weeds, which have never been evaluated for their emission. Several alternative fuels like briquettes of peanut wastes and coir dust are also being considered for commercial sale. These too have never been studied.

### House designs

A third major aspect of the wood smoke solution is to increase ventilation in the homes of the poor. Ventilation improvement could be the least expensive, short-term way to reduce smoke exposure. Relatively minor changes in existing structures like adding windows can make substantial changes. Just closing a 2 square meter hole in the ceiling of a small kitchen in Gujarat to mimic monsoon conditions resulted in an eight-fold increase in smoke exposure to the cook.

Moving the kitchen to a well ventilated area can also make a major difference. Women who cook in a porch, for instance, receive less exposure to smoke. Finally, the entire kitchen can be redesigned to increase ventilation but this means that ventilation consideration be taken into account while building the house itself.

The Gujarat study found that women in relatively richer households, living in pucca houses, were in fact worse off. Kuccha houses were generally better ventilated. In addition, the mixed and thatch and tile roofs were often quite well ventilated. Some pucca homes on the other hand had cooking areas that were nearly completely enclosed, with no openings other than doors. Poorer homes were more likely to use poorer and probably more smokier fuels.

But still there was more exposure to smoke in the pucca houses. Unfortunately, house designs are usually decided upon by the male in the house who can neglect the problems of the woman, also in some cases fear of theft may simply prevent households from making large ventilation holes.

It is equally important to study some of the cooking practices. Most women who cook on wood-fired chulhas generally squat or sit while cooking. This may be an adjustment over years to the high levels of wood smoke. Concentrations of CO and TSP are generally lower near the ground. Thus, it may be much more comfortable being closer to the gound and out of the region of higher smoke density.

### Policy options

These findings on the ill-effects of smoke have several implications for those involved in making national energy, environment, housing and health policies. Energy policy makers in India face no other option but to increase the supply of biomass fuels to meet the cooking energy needs of the poor majority. But this means that growing of less smoky tree species and introduction of smokeless stoves should get high priority. Stove designers will also have to ensure that designs are not just maximised to save on fuel but optimised both to save on fuel and reduce emission. Experience in the US shows that once one type of stove has been widely disseminated, then environment policy makers will find it very difficult to force promoters of these stoves or to get homeowners to make further modifications.

Those involved in rural housing will also have to ensure that any design they make for rural houses have a proper system for guiding the smoke out of the house. Simple ideas that could be incorporated into existing houses to increase ventilation will be very useful, though in many cases it must be recognised that many openings in mud walls, for instance, will greatly weaken the structure.

There are serious implications for health policy planners in these findings. Clearly there will be many problems if it is

## Wheels of Progress

For hapless residents of already overpolluted cities, there is bad news: the country is poised for a massive boom in vehicles on the road and their exhausts will prove a major health hazard. India should be producing 2,00,000 cars a year by the end of this decade. Permission has already been granted for the manufacture of 3.5 million two-wheelers also by 1990. A direct consequence of this surge in the number of vehicles will be a sharp rise in air pollution.

Delhi is a pointer to the future. According to Professor J.M. Dave, dean of the School of Environmental Sciences at Jawaharlal Nehru University (JNU), it is the worst polluted city in the country as far as vehicle exhausts are concerned. Dave and his team of researchers conducted a comprehensive air pollution survey and found that 400 tonnes of pollutants are vomited every day by nearly 5,00,000 vehicles. This amounts to 34 per cent of the smoke and dust emitted in the city, a higher proportion than anywhere else. What is more, over the past decade the pollution in Delhi has increased 75 per cent.

It is interesting to note pollution generated by different types of vehicles. Heavy vehicles—trucks and buses, mostly diesel—constitute only 8 per cent of the total number but consume 70 per cent of petroleum products and produce 47 per cent of pollutants. Two-wheelers and three-wheelers constitute 63 per cent of the number, consume 9 per cent of petroleum products and produce 13 per cent of the total pollution. However, scooters and motorcycles emit twice as much hydrocarbons as cars and the same as heavy vehicles. In other words, they contribute 29 per cent of all the hydrocarbons—eight times more, per unit of fuel consumed, than heavy vehicles. Two and three-wheelers are real culprits which explains why, despite so many more cars in Bombay, it isn't so badly off in this respect.

Vehicle exhausts are concentrated at arterial roads and junctions. The JNU researchers found carbon monoxide levels as high as 100 parts per million (ppm) over a few minutes and 5 ppm to 8 ppm on an eight-hour basis. Carbon monoxide is very toxic even in small doses and can damage brain tissue. Nitrogen oxides and hydrocarbons damage vegetation in addition to human health. Fumes from badly maintained internal combustion diesel engine can cause cancer.

A lethal contaminant in the atmosphere is lead—no less than 400 kg is released in Delhi every day. Traffic police and road and construction workers are particularly vulnerable to it. Samples from leaves on certain roads show a lead concentration of up to 5 ppm. Lead is an accumulative nerve toxin, which can cause irreversible damage like mental retardation and other extremely debilitating, but hard to measure, effects. Children absorb it five times faster than adults.

A.C. Pasricha

Sulphur dioxide is yet another major irritant. It triggers off a number of diseases in the respiratory system including bronchitis, asthma and breathlessness. Bombay is particularly ound that lung cancer is far more prevalent in rural areas han generally believed or that its incidence rises ramatically as the lifespan increases because of the control f other diseases. Just as supply of clean water is now onsidered an extremely important domestic need in the ural areas, these findings show that supply of clean air is lso a matter of high priority to rural women.

Rough calculations show that a tonne of particulates rom household stoves may actually lead to more than 500 mes the human exposure than a tonne of particulates from coalfired power plant. The cost of an improved smokeless tove may not even be Rs 100. Thus, the cost of eliminating ne gramme of particulate dose to human beings by installing mokeless stoves may be just about an eighth of eliminating ne gramme of particulate dose to human beings from a large oal power station. In other words, rural air pollution aused by traditional fuels could be far more serious and nore easily controllable than urban air pollution caused by nodern fuels.

These findings also pose a serious question to environnentalists: where should they direct their limited financial esources? Should these resources be used on a priority asis for control of air pollution in the outdoor environment ecause of, say, thermal power stations, or should the control of indoor air pollution because of woodsmoke get a higher priority?

fflicted by sulphur dioxide pollution because of the dense raffic—half the taxis and a fifth of the private vehicles in the ountry.

Noise is a much neglected pollutant. Two and threevheelers—particularly motor bikes with "rigged" ilencers—roar around at a decibel level of 92 at 40 km per hour. imilarly, heavy vehicles which have faulty transmission systems an raise 85 decibels to 97 decibels at 35 km to 50 km per hour. Residents of Daryaganj, where traffic jams are common, and the Ring road have more than their fair share of this din.

There are now an estimatd 900,000 cars in the country. Very ittle is being done to subject them, and heavy vehicles and wo-and three wheelers, to regular roadworthiness tests. According to one survey, only 65 per cent of the buses in a najor Delhi Transport Corporation (DTC) depot could pass itness tests if they were stringently applied. The Delhi dministration had issued a notification requiring vehicles over 5 years old to be re-registered—eight out of 10 motor vehicles n India are over 10 years old. However, it is easy to get an unroadworthy vehicle passed by a corrupt inspector.

Oil industry sources say that the use of 87–octane petrol, vhich was introduced in September 1983, will lead to less pollution, contrary to the popular impression. Fortunately, lead s easy to remove from petrol. Tetraethyl lead is usually added o increase the octane rating of petrol and reduce "knocking" Now, other additives are available. Two per cent added to the cost can apparently reduce the lead content from 0.4–0.5 gm per itre to 0.1 gm per litre; the Indian Standards Institution limit is .56.

Britain has banned lead in petrol and the US and Japan offer unleaded as well as standard petrol. "We have not yet done so because it would mean remodelling the existing engines and an idded expense for the consumer," says K.K. Ranganathan of the Central Board for the Prevention and Control of Water Pollution.

The board plans to monitor lead levels in Gauhati and Patna, vhere high lead petrol from refineries in Gauhati, Digboi, and Barauni is sold. Five refineries are producing 87-octane petrol hrough a process which does away with the addition of lead.

Although the Air (Prevention and Control of Pollution) Act vas passed early in 1981, a great deal needs to be done. Consciousness about the careless emission of industrial fumes s certainly increasing. But unless every state government starts ubjecting smoky engines to periodic inspections, there is little nope of ever cleaning up the atmosphere in major towns.

## POWER STATION POLLUTION

India needs power, and quickly. Increasingly, it is turning to superthermal power stations served by captive coal mines to get it (see box). With the discovery of large belts of low grade coal in parts of India, and the viability of transmitting electricity over long distances through 400 kv high transmission lines, the concept of energy parks—clusters of high-capacity power stations built around a central reservoir—was initiated in Indian energy planning in the last decade. Two such power centres are the Singrauli belt on the Uttar Pradesh — Madhya Pradesh border and Korba near Bilaspur in Madhya Pradesh.

However, there is a catch. Although concentrating thermal power plants near mines is cost-effective and reduces coal transportation headaches, the energy clusters pose serious air and water pollution problems. Singrauli and Korba are already beginning to exhibit signs of serious environmental damage and unplanned urbanisation. The damage has not gone unnoticed in high places: in early 1984, Deputy Environment Minister Digvijay Sinh warned a group of industrialists that if pollution control measures were not taken by thermal power plants, acid rain would hit India within 10 years. The Chairman of the Central Board, for the Prevention and Control of Water Pollution (CBPCWP) Dr Nilay Chaudhuri, said in a newspaper interview in June 1984 that out of 48 thermal plants surveyed, 31 had taken no pollution control measures. The pollution control equipment in only six out of 17 plants which had installed it was functioning adequately.

**Superthermal power projects (STPP) under implementation.**

| | |
|---|---|
| **Singrauli** | |
| Ultimate installed capacity | 2000 mw |
| Total investment | Rs. 1,335.2 crore |
| **Korba** | |
| Ultimate installed capacity | 2100 mw |
| Total investment | Rs. 1,635.8 crore |
| **Ramagundam** | |
| Ultimate installed capacity | 2100 mw |
| Total investment | Rs. 1,885.1 crore |
| **Farakka** | |
| Ultimate installed capacity | 2100 mw |
| Approved capacity | 600 mw |
| Total investment | Rs. 610.4 crore |
| **Vindhyachal** | |
| Ultimate installed capacity | 2260 mw |
| Approved capacity | 1260 mw |
| Total investment | Rs. 1,110.4 crore |
| **Rihand** | |
| Ultimate installed capacity | 3000 mw |
| Approved capacity | 1000 mw |
| Total investment | Rs. 1,033 crore |

Source: 'NTPC's flying start', Rajiv Shirali, Business World, November 21 — December 4, 1983.

### Murky future

With such scant disregard for the environment in the rush for power, the future cannot but be murkier, in the complete sense of the word. In that context, the energy parks could prove a mixed blessing. It is likely, however, that expediency will win the day. It is calculated that the Singrauli belt contains enough coal to feed a dozen thermal plants with a total installed capacity of 20,000 mw for a hundred years. The 466 sq km Rihand reservoir, formed in 1960, is a readily available source of cooling water. The first National Thermal Power Corporation (NTPC) power plant to be commissioned in the area was the Singrauli Superthermal Power Station at Shaktinagar, with a total installed capacity of 2,000 mw, of which 1,000 mw had already been commissioned by 1984; the plant will be fully operational by 1988. Another NTPC power station is coming up across the border in Madhya Pradesh, only a few kilometres from Singrauli: the Vindhyachal Superthermal Power Station with an approved capacity of 1,260 mw and an ultimate capacity of 2,260 mw. Across the Rihand reservoir is the third NTPC plant under construction, the Rihand Superthermal Plant with an approved capacity of 1,000 mw and an ultimate capacity of 3,000 mw.

Besides the NTPC plants, there are others within a radius of 30 km. One is the near complete Anpara Superthermal Power Plant of the Uttar Pradesh State Electricity Board (UPSEB) which will ultimately generate 3,130 mw. A few kilometres from it is the 185 mw Renusagar thermal plant, built by the Birlas for their Hindalco aluminium plant in nearby Renukoot. Further north is another UPSEB plant at Obra on the river Sone. Excluding the Rihand project, within a few years there will be five thermal power plants operating close to each other. Individual plants may have allowed for pollution, but what has not been adequately taken into account is the cumulative impact of so many plants operating alongside open cast coal mines and other industries. Also, the power plants will lead to the growth of large townships, and one million people are eventually expected to live in the area, all depending on the Rihand reservoir for water.

### Combustion problems

The problems of pollution begin with the coal itself. Open cast coal mines produce huge clouds of dust following blasting operations. The large quantities of overburden (loose soil removed from the mines), which surround the mines are an unaesthetical blight on the region and increase the quantity of dust. The scores of diesel burning trucks in the vicinity of these coal mines, used for transporting the coal, add their share to the general pollution of the area.

Although Indian coal has a low sulphur content of 0.35 per cent, its ash content averages a high 30 per cent. In addition, coal combustion leads to the emission of a number of harmful gases, especially sulphur dioxide, which is as harmful to humans and animals as it is to vegetation. It also leads to acid precipitation or acid rain, as observed in Western Europe and parts of North America. The scale of coal use in the superthermal plants—the Singrauli plant alone, when fully operational, will need 29,000 tonnes a day—offset the advantage of the low sulphur content. A 1978 study by Dr C.K. Varshney of the School of Environmental Sciences of the Jawaharlal Nehru University, New Delhi, revealed that the estimated sulphur dioxide emission from coal combustion in India had increased from

0.60 million tonnes in 1964 to 1.10 million tonnes in 1979.

Sulphur dioxide emissions can be greatly reduced by a desulphurisation process using wet or dry scrubbers. The height of the chimney stack can also limit sulphur dioxide concentration. But none of the plants is taking any desulphurisation steps because of the additional cost. What s more, the NTPC plants have installed extra tall chimney stacks, 220 metres high, which will only spread the pollution over a wider area.

Fly ash emission is another hazard. It reduces visibility and is a considerable health hazard as it contains many trace elements, including arsenic, cadmium, chromium, mercury, ead, manganese, vanadium, fluorine and beryllium. Electrostatic precipitators can greatly reduce these emissions; those currently available are 99.7 per cent efficient. All the NTPC plants and the Anpara project have hem. But the Renusagar plant does not and the effect of the ly ash smoke its chimneys vomit is enough to obliterate the view of the countryside for miles around.

Ideally, both precipitators and mechanical filters should be used, because of the coal's heavy ash content: filters would remove the heavier particles and precipitators would deal with the finer ones. At present most plants have only precipitators and their efficiency is often lowered because hey have to deal with a much heavier load that for which hey were designed. There are frequent breakdowns and every time they are restarted it takes them a while to reach optimum efficiency. Meanwhile, an enormous amount of fly ash has escaped. Furthermore, precipitators can emove only about half of the finer particles and the rest escape through the stacks, whose height helps to spread the ash over a wider area. Fine ash is more harmful because it can be easily inhaled.

## Dangerous levels

D.R. Ahuja of the Tata Energy Research Institute has prepared a discussion paper on potential environmental problems in the Singrauli belt, more specifically in a 30 sq km area with five thermal power plants. The sulphur dioxide concentrations, at 1.3 μg/cum to 1.5 μg/cum, will be 10 times higher than the eight-hour standard for industrial areas set by the CBPCWP 0.12 μg/cum. The standard for suspended particulate matter (SPM) is 0.5 μg/cum; in this area it will be between 0.48 μg/cum and 0.53 μg/cum. These calculations do not take into account existing background concentrations which include coal dust, vehicular exhaust and emissions from various industries. Ahuja also points out that a one per cent drop in the efficiency of the electrostatic precipitators will lead to a doubling of concentrations. To top it all, Dr Nilay Chaudhuri says that Singrauli will have to maintain standards set for residential areas because of its projected large population; the standards are 0.08 μg/cum of sulphur dioxide and 0.2 μg/cum of SPM.

The water problems are no less disheartening. Most of the NTPC projects will draw cold water from the Rihand reservoir to dump it back at a temperature which NTPC officials say will have risen by only 1.5 degrees but which critics feel could have risen much more because of the combined effect of several power stations. According to Dr Varshney, the temperature rise can cause serious changes in the water body: dissolved oxygen, for one, can drop to critical levels. The rise will definitely affect the feeding habits and reproduction rates of fish—the reservoir has

## Power Play

The power crisis has become a fact of life in India—and not just on the political front. The shortfall in 1984-85 is expected to be 6 per cent, in itself not too bad, but the picture varies enormously across India: at various points in the year, Rajasthan will face a 45 per cent shortage, Orissa 35 per cent and Karnataka 40 per cent. Even pampered Delhi will not be spared.

The consequences are legion: farmers starting irrigation pumps at the dead of the night, patients dying on the operation table, factories running much below capacity or not running at all and so on. In Tamil Nadu, ironically even a factory producing raw materials needed to manufacture solar cells —devices that generate electricity from abundant solar energy—is planning to move out to Andhra Pradesh because of repeated power cuts. In macro terms, Federation of Indian Chambers of Commerce and Industry (FICCI) believes that a 'normal' 10 per cent shortfall leads to an annual production loss of Rs 7,000 crore. It quotes a World Bank study which says that the shortage has reduced the annual economic growth rate by one per cent to 3 per cent in each of the last three years.

India's power generating capacity has admittedly grown rapidly, but not rapidly enough. From 2,300 mw in 1950 it is now over 40,000 mw. The sixth plan allocated Rs 19,265 crore to commission another 19,666 mw but the actual increase during the plan period is expected to be 14,500 mw. The seventh plan, which has yet to be finalised, proposes to spend Rs. 67,900 crore on another 29,500 mw.

But even such great leaps forward might not be enough because on current demand trends alone, India will need 138,000 mw of power generating capacity by the turn of the century. The government cannot keep up with its present projects: if all irrigation pumpsets were to be energised by 1984-85, as the plan is, the connected load in the agricultural sector will be 24,000 mw. Electricity demand is growing rapidly for irrigation. In two years, 1978-79 and 1979-80, some 0.64 million pumps were energised adding a connected load of 2500 mw. Not surprisingly, many industrial companies are going in for captive sets, which now account for 3,000 mw or about 7 per cent of the national power generation. A further 2,500 mw has been cleared and more applications are in the queue.

Power planning has increasingly emphasised coal based thermal power stations because of the long gestation periods of hydro and nuclear projects, and because of India's extensive coal reserves. During 1970-80 thermal power capacity grew at an annual rate of 8 per cent while total capacity grew at 7.2 per cent. At present thermal power stations — 215 units of 20 mw plus capacity — generate over 21,000 mw, more than half of the total generation. The approach paper to the seventh plan has stressed coal-fired superthermal plants: by 2000, some 84,000 mw of thermal capacity will be needed, unless energy conservation measures are taken.

The reason for the thermal thrust — over 90 per cent of capacity developed in the sixth plan period was thermal — is simply that India has lots of coal: at least 86.43 billion tonnes, according to the 1978 estimate of the Geological Survey of India, and possibly as much as 111.88 billion tonnes. About 56 million tonnes is currently used up every year by thermal power plants and by 2000 they will consume 195 million tonnes a year.

The current concept is of large plants at coal pitheads, which allow for power planning on a regional rather than a state basis. Six superthermal stations are coming up at Singrauli, Farakka, Korba, Ramagundam, Rihand and Vindhyachal. Singrauli, on the Uttar Pradesh-Madhya Pradesh border, will have a total capacity of 2,000 mw — five 200 mw units already commissioned and two 500 mw units under construction. Korba is of 2,100 mw capacity — two 200 mw units in operation, with another 200 mw unit and five 500 mw units in line.

considerable potential for fishery.

Furthermore, smaller fish are sometimes sucked into the condenser pipes of the plant despite trash screens. Reduction in their number affects the nutritional intake of the larger fish. Ahuja suggests that one way of minimising the damage would be to draw water from a location well away from the fish spawning areas. This would, however, add to the cost, because of the increased length of the pipes and the additonal energy required for pumping.

The water supply is also affected by the ash which is carried in the form of slurry from the plants. In Singrauli, concrete-lined ash dumps, covering 2,000 acres in all—a little under half of the total project area—are being built on the reservoir's shore. But the water from these dumps, carrying the trace elements from the ash, flows back into the lake and over a period of time and on a large enough scale this cannot but affect water quality.

### Threatened reservoir

Interestingly enough, the preliminary project report prepared by the NTPC on the Singrauli project had suggested that building ash dumps near the lake was not an environmentally sound idea as it would ultimately reduce the area of the reservoir and also lead to harmful salts in the ash leaching into the lake. So far no alternatives have been considered although it has been suggested that the ash could be used to fill up used mine pits, covered with over burden and then afforested, as has been successful in Britain and West Germany. The CBPCWP is also emphasising the safe disposal of fly ash and has suggested setting up units near the plants to make cellular concrete blocks out of fly ash.

Also affecting the reservoir in the long run will be the increasing run-off from the surrounding area because of the large amounts of overburden loose soil. The coal belt runs under what are at present reserved or protected forests

## Generating A Furore

Tata Electric Companies (TEC) has recently obtained permission to go ahead with the controversial second 500 mw thermal power station. The Department of Environment, which was called in after fierce protests from Bombay environmentalists, has reportedly insisted that the plant can run only on Bombay High gas, and not coal. The Central government is said to have agreed to supply the low-sulphur gas because there has been inordinate delay in finding users for a valuable natural resource currently being flared—over Rs 22 lakh worth a day.

The controversy began seven years ago when TEC proposed its first 500 mw unit at Trombay. The Chembur-Trombay region already housed four TEC thermal power units in one complex. Also jostling for air was the huge Rashtriya Chemicals and Fertilisers Ltd (RCF) and two oil refineries. Chembur, a major residential area known as Gas Chembur, accounts for nearly half the sulphur dioxide, nitrogen oxide and particulate matter (dust particles) in the entire city and almost all the hydrocarbons and carbon monoxide.

Dr A. Soares, a trustee of the Society for Clean Enviroment (SOCLEEN) which is based in Chembur, says that the local population runs the risk of contracting several diseases. In a recently conducted pollution survey and subsequent observations, he noted that common ailments include colds, coughs, allergic respiratory diseases and complaints of the eyes, nose and throat. Foul air destroys greenery and damages structures, peels paint off walls, corrodes cupboards and metal structures.

So when Tatas announced plans to set up their sixth unit in this area, the environmentalists—notably SOCLEEN, the Bombay Environmental Action Group (BEAG) and the Save Bombay Committee—got ready for battle. Says Saad Ali, vice president of BEAG: "when we protested against the installation of Tatas' fifth thermal unit of 500 mw in 1978, we were told that it was too late as the licence had already been cleared. This time, we have been vigilant for the last three years, so that there can be no excuse."

The four old units have a total capacity of 330 mw; the first 500 mw plant started up early in 1984, raising the capacity to 830 mw. Tatas had proposed the fifth unit as a replacement to the first four: now the sixth is proposed as a replacement for these. The environmentalists, however, point out that Bombay's power needs can only grow and it is unlikely that the older units will be scrapped. For instance, the Bombay Gas Co at Lalbaug, already a hundred years old and a major source of pollution, has not yet been scrapped.

The environmentalists back their fears with hard projections based on the assumption that the power stations will use coal as fuel. In that case, the sixth unit will add 101 tonnes of sulphur dioxide every day to the already substantial daily contribution of 168 tonnes from the first five units. Similarly, the unit will daily add 53 tonnes of nitrogen oxides and 73 tonnes of particulate matter to the atmosphere, a mark-up of 62 per cent and 60 per cent respectively on its predecessors' contributions.

In the last three years, from 1981 to 1983, surveys conducted by the Bombay Municipal Corporation have showed higher and higher levels of dust and sulphur dioxide in the air, inspite of the fact that no new major air polluting industry has been permitted in the city. The silver lining is that, in Chembur-Trombay, levels of pollutants have dropped because both the fertiliser factory and the fifth power station are using Bombay High gas. If the fifth plant were to use coal, as it is equipped to do, it would raise the 24-hour sulphur dioxide average to 80 micrograms per cubic metre ($\mu$g/cum) when the Air Pollution Prevention Act of 1981 specifies that the level should not rise above 30$\mu$g/cum.

BEAG contends that the south-west winds during the four months of the monsoon and the north-west winds in the other months carry pollutants into land areas, contrary to the Tatas' claim that the flue gases will be carried away towards the sea. The plan is located on the Thane creek, between the island of Bombay and the mainland, and this is too inadequate a sink for pollution.

The Tatas have also been accused of consistently misrepresenting their position. They have made every effort to confuse issues, such as the number of people affected by the plant, the too-good-to-be-true expectation of 99.8 per cent efficiency from their electrostatic precipitators, and by taking figures for pollution when 60 of Bombay's textile mills were closed.

Over and above this is the all-too-important question: how long will the power station be allowed Bombay High gas? By 1985, RCF's 4,500-tonne a day urea plant at Thal Vaishet will go onstream, followed by a petrochemical complex. These will be given preference over the power stations, as will domestic consumers clamouring for LPG. If the power stations are forced to shift to coal, the sixth unit alone will consume 1.8 million tonnes a year and the BEAG estimates that all units will need 5 million tonnes annually. Transporting the fuel in such quantities, by rail or by sea, will lead to chaos. Thus, while the two refineries are trying to reduce traffic congestion by laying pipelines to carry their products, the thermal plant may do exactly the opposite.

If coal is to be the staple fuel, a major worry is the ash and waste generated by the mammoth power stations. The company said that they would spread the waste over 600 hectares of marsh but quickly changed their plan when it was pointed out that the ash would be radioactive and would necessarily have to be moved out of the city, giving transport authorities nightmares. Dumping in the sea would cause tremendous ecological damage. Now the Tatas are talking about making bricks out of the ash.

The one solution would be to move the plant itself to a safe distance from the city—for example, to Chola near Kalyan, 100 km from Trombay. Then perhaps Bombay would be saved from asphyxiation.

bearing mainly sal, bamboo, khair and salal trees. To get at he coal, these forests are being destroyed and the marked decrease in green cover in the area immediately around the eservoir will also increase the rate of siltation.

Last, but certainly not the least, is the mammoth urban sprawl, of about a million population that the power stations will spawn over the next decade or so, making it one of the 50 biggest cities in India. The fact that it will be on both sides of the border will create administrative problems. Although a number of so-called coordination committees have been ormed, development on one side of the border carries on ndependently of the other. Madhya Pradesh has created a Singrauli Special Area Development Authority (SADA)—which, incidentally, has yet to get the Rs 15 crore to acquire he land for a 48 sq km township—but Uttar Pradesh is yet to do so. There are at least three master plans in preparation and to add to the confusion the NTPC and Central Coalfields, which manages the coalfields, are setting up their own townships for their employees. Meanwhile slums and shanty towns have begun to grow.

**Installed capacity for power generation**

| | 31.3.1980[1] | 1984-85[2] | 2000-01[3] |
|---|---|---|---|
| Hydro | 11,384 | 14,445 | 49,000 |
| Nuclear | 640 | 1,330 | 5,000 |
| Thermal | 19,001 | 26,974 | 83,859 |
| Total | 31,025 | 42,749 | 1,37,859 |

Source

(1) Sixth Five Year Plan (1980-85), Planning Commission

(2) Central Electricity Authority

(3) Reference Level Forecast, Report of the Committee on Power, Ministry of Energy, 1980.

## Korba complex

Much of what is feared for Singrauli has already happened at Korba, about 125 km east of Bilaspur in Madhya Pradesh, where the state's first heavy industrial complex is coming up. The state government now concedes that each of the major units there—the Fertiliser Corporation of India's coal-based plant has finally been abandoned—has been planned with little thought for overall design. The reason for the industries being there is the easy availability of low grade coal and water from the Hasdeo river. But no one foresaw the air pollution caused by burning large quantities of coal, when its ash content was an extremely high 50 per cent.

The oldest unit is the Madhya Pradesh State Electricity Board's thermal power station, whose first generator was commissioned in 1959 and whose units generate a total of 540 mw. Unfortunately, the electrostatic precipitators are installed on only two 120 mw units and the difference in emission is clearly visible when all the units are functioning: the 120-metre stacks spew a dirty pall for miles around. Things are expected to be better at the NTPC's massive 2,100 mw Korba Superthermal Power Project each of whose units will be blessed with a precipitator. There will also be an ash dyke to prevent flyash from going into the river and the authorities hope to use the ash to make bricks and cement.

Things are quite uncomfortable on the home front, with 2 lakh people already living in a ramshackle township with atrocious roads. Most of these people are employed by public sector companies like Madhya Pradesh State Electricity Board, National Thermal Power Corporation, Western India Coalfields and Bharat Aluminum Corporation. Residential complexes were built wherever land was available around each plant. A special area development authority has been set up—too late, it appears. However, efforts are being made to make the area livable. Colleges are being built, and the big employers are going in for tree-planting in a big way to combat the tonnes of dust and gases regurgitated by the plants every day. Planners in Bhopal say that Korba's mistakes will be avoided in Singrauli. "We are trying to take steps before the damage is done," says one. One person who is unconvinced that the damage can be prevented is the Director of the Madras-based Murugappa Chettiar Research Centre, C.V. Seshadri who says in a telling adaptation of a well-known dictum: "Power pollutes, superthermal power pollutes superthermally."

### Killer Rain

This is no gentle rain from heaven upon the place beneath, but a deadly shower. Industries, automobiles and power plants hurl millions of tonnes of nitrogen oxides and sulphur dioxide into the air. They are transformed into nitric and sulphuric acids, which ultimately get washed down with rain. Vast tracts of forest and lakes in Europe and North America have been or are being destroyed by this killer rain. In Sweden alone 15,000 lakes have been acidified as have thousands in Norway, the US and Canada. Acidity kills off fish, bacteria and algae and the aquatic ecosystem collapses into sterility leaving a crystal-clear but ultimately dead lake.

Ironically, acid rain is an international issue because of efforts by experts to control pollution locally. When cities like London began to choke engineers built tall chimneys to diffuse and disperse the pollutants. But the winds carried them to other countries. In fact, English pollution now descends upon Sweden as acid rain.

Acid rain is defined as one with a pH of less than 5.6. The pH is a measure of acidity and alkalinity: the pH of distilled water is 7.0 and a pH measure above and below this signifies alkalinity and acidity, respectively. The scale is logarithmic—rain of pH 4.6, common in eastern North America, is 10 times more acidic than rain of pH 5.6. At home, observations of rain in Trombay and Chembur in Bombay in 1974 revealed rain of pH 4.5 and 4.8, respectively. Acid rain has also been reported from Delhi, Nagpur and Pune.

"The current pace of development is bound to promote acidification of the Indian environment," says C.K. Varshney environment expert at the Jawaharlal Nehru University, Delhi. Coal production has increased from 35 million tonnes in 1950 to 150 million tonnes in 1980 and will probably reach 240 million tonnes by 2000. Total sulphur dioxide emissions in the country increased from 1.38 million tonnes in 1966 to 3.20 million tonnes in 1979, an increase of 21 per cent—more than twice the increase of 8.4 per cent in the US during the same period. Of course, sulphur dioxide emissions in India are much less than that in the US but with the rapid expansion in the thermal power generation programme, acid forming gases will be added to the atmosphere in ever greater quantities. "We should learn from the experience of industrialised countries and prevent progressive acidification of the environment," pleads Varshney.

According to Swedish experts acid rains is a boundless threat to the environment. Acidification of the soil changes its biology and chemistry. For example, when the soil becomes acidified, plants can absorb cadmium more easily. Swedish cultivated plants exhibit ever higher cadmium levels, a serious threat for human beings and animals. The cadmium content of wheat has doubled in Sweden in the course of the 20th century.

# HABITAT

*India's urban population is today the fourth largest in the world. By the end of the century, it will be the largest. Managing such a large urban population will call for extraordinary imagination and political will.*

*As towns and cities grow, they gobble up precious agricultural land: some 1.5 million hectares already since 1950 and probably another 0.8 million hectares in the next 20 years.*

*Conservative official estimates, put the existing slum population at over 30 million and growing. By current trends, 75 per cent of Bombay's population will be living in slums at the turn of the century.*

*Unable to find or implement imaginative solutions, authorities in Bombay and Delhi have armed themselves with laws: squatting is today a criminal offence in these cities and squatters can be arrested without a warrant and held without bail.*

*If India wants to house its entire urban population, it must accept cities of shacks, not those built to please the foreign visitor. People must be allowed to improve their housing wherever they are.*

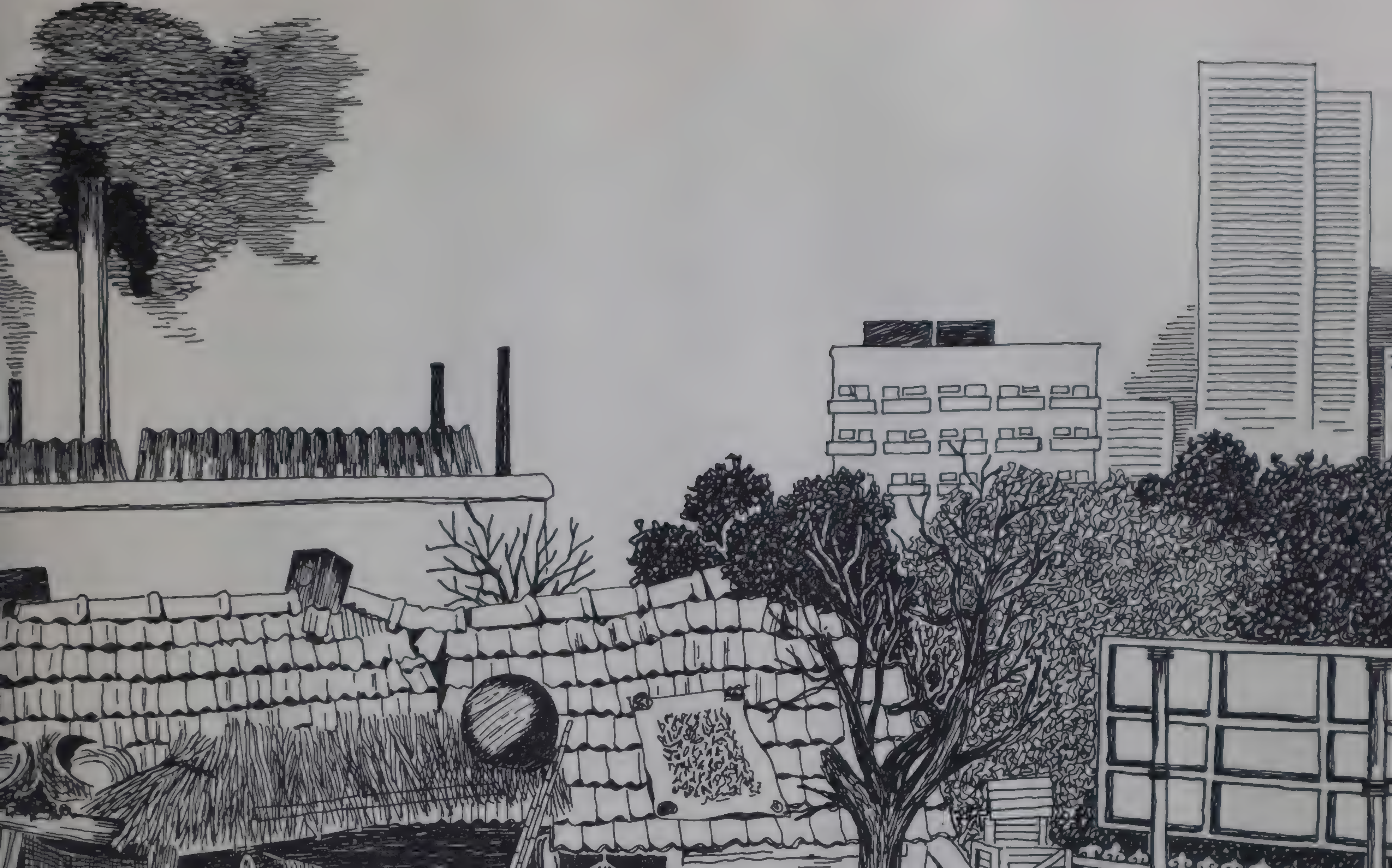
*Though the Central government officially accepts slum upgrading as the answer to the country's gigantic housing crisis, it is not able to fulfil its minimal targets. By 1985, there will still be 20 million people outside the ambit of slum upgrading schemes.*

*For the success fo slum upgrading programmes, the key issue is security of tenure. The best slum upgrading effort is in Hyderabad, where security of tenure has been assured.*

*The face of urban India is rapidly changing. Bangalore, Pune and Dehra Dun, for long praised as idyllic—cool, green and quiet, are today boom towns—noisy, dusty and hot.*

*Hill stations are dying everywhere: Ooty in the south, Mahabaleshwar-Panchgani in the west, Darjeeling, Gangtok, Shillong, Mussoorie and Simla in the north. With tourists pouring in, forests have been destroyed and water crises are common.*

*As people get pushed out of villages and into cities with little industry, they bring their rural occupations with them. Allahabad's livestock population has been growing faster than its human population. The city's municipal authorities make no pretence of even trying to cope.*



The cities are booming. In 1981 India's urban population of 156 million was the world's fourth largest, behind only USA, USSR and China. By 1985, only China's is expected to be bigger. By 2000 AD, India's towns and cities will have anywhere between 350 million and 400 million inhabitants. There will be 20 cities with more than a million people each, and Calcutta, Bombay, Delhi and Madras will have more than 10 million each.

Planning for this urban colossus will be a Herculean task. At the moment it looks like a losing battle. Despite 60-odd statutory development authorities in various cities and regions, slums continue to grow. The Planning Commission estimates that over 30 million people, one-fifth of the urban population, live in slums. Other estimates make it 30 per cent.

Some 3-5 million slum dwellers live on about 8,000 acres of Bombay's land: over 400 persons per acre. By current trends, 75 per cent of Bombay's population will be living in slums by the turn of the century. Some 100,000 people already live on the pavements, which is better than in Calcutta, where an estimated 600,000 people go to sleep every night in the streets. Bombay can boast of having the world's biggest slum, a sprawling conglomeration of shanties called Dharavi.

Conditions in the slum are more than shocking. A survey of about 4,000 households in nine slums in Bombay reveals that nearly 40 per cent have two to four persons packed into one room, another 35 per cent households have five to nine persons crammed into one living room, and one per cent have 10 or more persons living in one room.

No house has a private toilet. A quarter of the households do not even have access to community toilets and use the open spaces around the slum for defecation. Over a third have no drainage facilities and another 40 per cent have uncovered drains. This lack of amenities makes the slum environment extremely dirty and prone to sickness.

Planning and legal systems, marked by upper class values, have turned slum dwellers into second class citizens. Leading urban planner M.N. Buch says that the "real tragedy of urban India" is that the "texture of the built environment of the city is judged not in terms of what it provides to the citizen but rather what visual picture it presents to a (foreign) visitor."

For years local and national government agencies reacted by bulldozing the shacks. Sometimes efforts were made to resettle the slum dwellers in 'pucca' (cement) houses in so-called slum clearance and resettlement schemes. By end-1976, the government had built about 1.16 lakh houses to accomodate displaced slum dwellers. But the houses, built with construction standards and regulations meant for the middle classes, proved prohibitively expensive. Moreover, the cheapest tenement could not be afforded by 50 to 70 per cent of the urban population. As a result, houses built for low income groups have been acquired by middle income groups and houses for middle income groups by upper income groups.

**Growth in population of major Indian cities ('000)**

| | 1901 | 1951 | 1961 | 1971 | 1981 |
|---|---|---|---|---|---|
| Calcutta U.A. | 1488 | 4589 | 5737 | 7031 | 9166 |
| Greater Bombay | 813 | 2967 | 4152 | 5971 | 8203 |
| Delhi U.A. | 214 | 1437 | 2359 | 3647 | 5752 |
| Madras U.A. | 594 | 1542 | 1945 | 3170 | 4277 |
| Hyderabad U.A. | 448 | 1128 | 1249 | 1796 | 2566 |
| Ahmedabad U.A. | 186 | 877 | 1206 | 1742 | 2515 |
| Bangalore | 159 | 779 | 1200 | 1654 | 2914 |
| Kanpur U.A. | 203 | 705 | 971 | 1275 | 1685 |
| Pune U.A. | 164 | 606 | 791 | 1135 | 1685 |
| Nagpur | 128 | 449 | 644 | 930 | 1298 |

Source: The Times of India Directory and Yearbook, 1982.

The new strategy, now accepted widely, is to let slums stay, and to provide water, drainage, community latrines and paved streets. Both the draft five year plan (1978–83) prepared under the Janata government and the Sixth Five Year Plan (1980–1985) prepared under the Congress (I) government have stated that substantially increased investments will have to be made in slum improvement.

From 1972 to 1980, some 7 million people are estimated to have already benefited from slum improvement schemes and another 10 million are expected to benefit, under the sixth plan. But at the end of the plan some 20 million people will be left uncovered, with millions more rushing to join them from the village.

To understand how slum improvement can be an answer, it is important to know something about the slum dwellers. Who are these people? What do they do? Why do they leave their villages to come and live in urban cesspools? What are their hopes and ambitions?

## Unemployment myths

In a country like India, urban poverty and rural-urban migration are closely related. When cities grow at yearly rates of 5 per cent or more, as Bombay, Calcutta, Madras, Delhi, Hyderabad, Bangalore, Ahmedabad have over the last three decades, at least half the growth is caused by net 'in-migration', concentrated very heavily in prime working ages, swelling the urban labour force, holding down wages and incomes in the urban economy, straining housing and related urban services to their limit.

But the belief that such migrants are unemployed parasites is absolutely incorrect. Survey results from Calcutta, Bombay, Delhi and Madras clearly show that most migrants find jobs fairly quickly, suggesting pre-arranged employment. A recent study of unemployment in Calcutta, for instance, found that unemployment was high among urban-born, educated youth but very low among the poorer sections.

Muslim migrants from Bihar and eastern Uttar Pradesh were largely absorbed in the city's jute industry. Hindus from rural Bengal were concentrated in the engineering, chemicals, rubber and printing industries. Calcutta's rickshaw pullers are largely migrants from Bihar and Orissa. The occupations of plumbers, domestic servants and paan-wallas are dominated by people from Orissa, and tanning and leather works are largely a Bihari Muslim activity. Vast occupational networks are at work among the poor to find work for the newcomer.

In Bombay, textile mill workers are mainly from the Maharashtra districts of Ratnagiri, Sangli and Satara. Construction workers are largely from Andhra Pradesh. Restaurant and catering industry jobs are cornered by young migrants from Udupi, Karnataka. Paanwallas and roadside food vendors are usually 'bhaiyas' from Uttar Pradesh.

A study of Bombay's labour market points out that less than 15 per cent of the poor migrants studied were unemployed, and that most of them regarded themselves as better off for having moved to the city. This study shows that the duration for which a migrant remains unemployed is related to the resourcefulness and 'influence' of friends and relatives: "Majority of the migrants (77.7 per cent), have some support during the period of waiting (for a job). Family members and relatives form the largest single source which helped 45 per cent of the migrants. Caste fellows and friends from the native place each helped 11 per cent of the migrants get jobs. Of those with none to support them, 61 per cent took up employment (usually of the casual variety) immediately."

Another recent study of employment patterns in Delhi found that the majority of those who were landless labourers before migration became unskilled labourers in Delhi. Those who were dhobis and domestic servants continued in those occupations after migration to Delhi.

Another important reason for higher employment among migrants is that most tend to be between 15 and 25. They enter the labour force immediately, and many take low-status, low-paid jobs. By contrast, urban natives who

## The Urban Juggernaut

Like a rampaging demon, modern cities are encroaching on agricultural land at an unprecedented rate. Some 1.5 million hectares of rural lands have been lost to them over the last 30 years as another 0.8 million hectares will be before 2000 AD.

For instance, the oil refinery at Bad, Mathura district and the industrial estate in Agra district have transformed the area around the Delhi-Agra rail route from farms and fallow lands into a continuous stretch of industrial and urban structures. Brick kilns have also proliferated. Large petrochemical-based industries have sprouted around the Koyali refinery, Baroda, and the same will happen in the environs of the Mathura refinery. Large industries will lead to small ancillary units, residential blocks for workers, shops, banks, theatres and so on. Approximately 50 square kilometres of agricultural land will be lost during the next 10 years.

Good agricultural land is being destroyed to produce bricks: the silt loam soil used by brick kilns is ideal for agriculture. To house the existing urban population alone nearly 3,000 million tonnes of soil — mostly topsoil — will have to be excavated. Apart from the loss of fertile soil, the present unplanned excavation is leading to soil erosion and water stagnation, which in turn leads to soil salinity.

As vertical development in cities has limitations, they increase horizontally. Delhi's urban villages stand out in sharp contrast to the new housing colonies developed around them. Masjid Moth, Kotla, Bar Sarani and Sheikh Sarai, are all eyesores from the architect's and urban planner's point of view. Such villages merge their identity into the surrounding urban mainstream by maintaining a basically rural structure but by giving up rural functions such as agriculture. Many more villages on Delhi's fringe are on the verge of being included in this category, turning into a type of slum.

The 1981 Annual Report of the Indian Council of Agricultural Research (ICAR) mentions a study which concluded that the urban area of Delhi increased from 43.3 sq km in 1901 to 660 sq km in 1981, an increase of about 1,524 per cent. Because of this, the net sown area for agriculture in Delhi has decreased from 94,000 hectares in 1951 to 78,200 hectares in 1971. Out of the union territory's 246 villages, 111 villages have come within the city's fold during this period. In villages like Sanoth and Ghonga, brick kilns have mushroomed, misusing highly productive agricultural land.

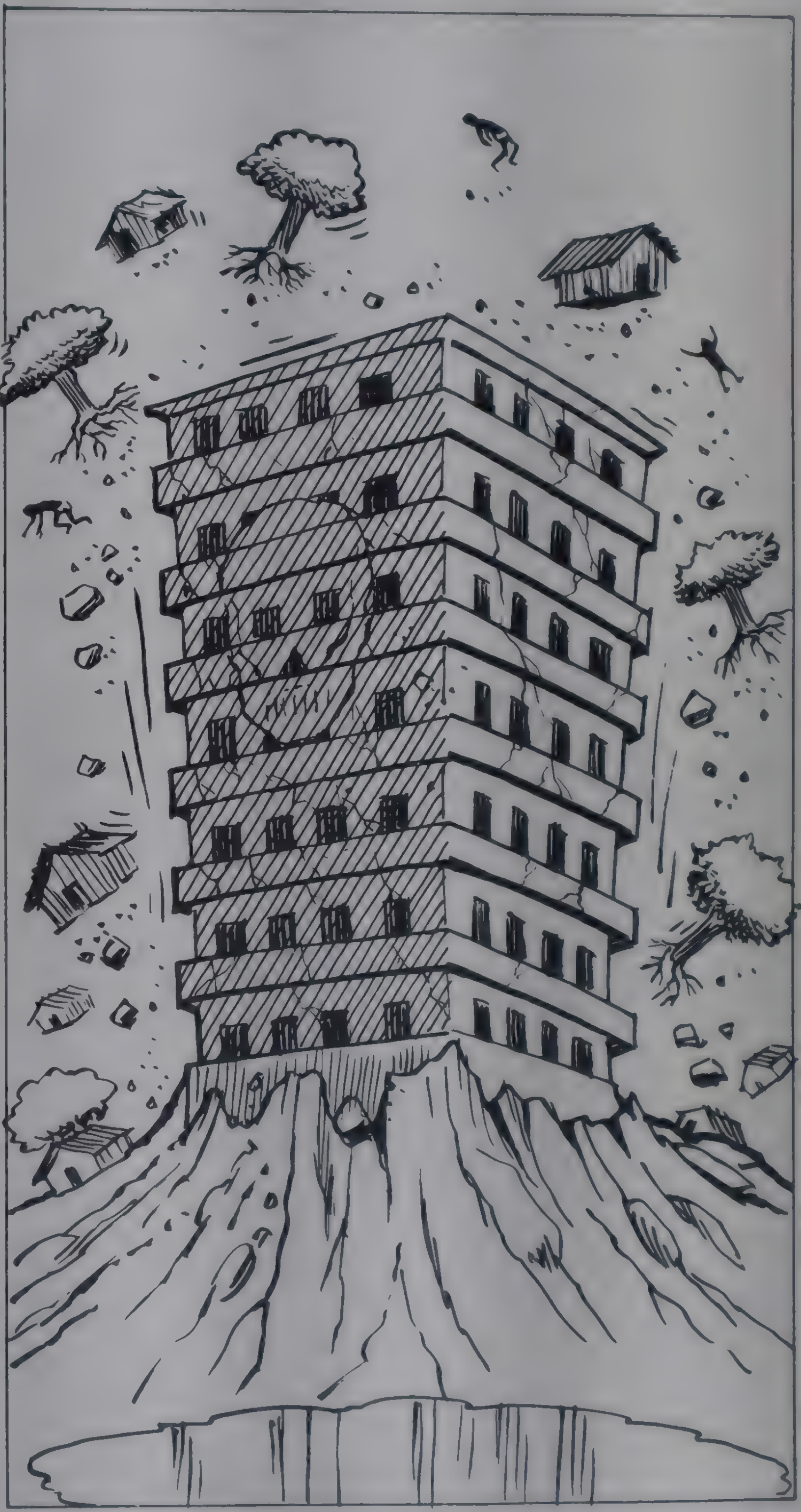
In the expansion drive eventual problems are disregarded. Floods and water stagnation affect areas like Jahangirpuri, where large numbers of slum dwellers have been resettled, every year. The area is in fact a basin and water stagnation is natural in such areas, especially because of the high water table due to the Yamuna nearby. The Delhi Administration has allocated Rs 10.9 crore for flood control during the year 1983-84, one third of the education allocation, and around 42 per cent of the allocation for medical services and public health. It is around 23 per cent of amount allocated to housing and urban development, which itself necessitated this expenditure on flood control. Already crores of rupees have been spent on flood control stuctures like the embankment on the bank of the Yamuna.

Delhi has been settled seven times in the historical past and never has it occupied such low lying lands. One of the advantages of settlement in low areas is the reduced cost of construction. It will be worthwhile to compare the expenditure for land development in upland areas in Delhi with the recurring expenditure on flood control in low lying areas. This would also avoid urban encroachment on good agricultural land in the west and north of Delhi where urban growth is taking place rapidly. From an appropriate land use point of view, Delhi should have expanded towards the south.

Even around smaller cities the loss of agricultural land is alarming. An area of 2,630 hectares was encroached upon between 1950-73 in Saharanpur district, according to a recent study. As much as 94 per cent of the encroached area was earlier cultivated, in all phases of growth, the percentage of good quality agricultural land to total encroached land is reported to have been above 60 per cent, and as high as 78 per cent in one phase.

The nearness of two large towns accelerates the pace of urbanisation in the villages between the two. Kanpur and Lucknow, Mathura and Agra, Delhi and Faridabad, Indore and Dewas are all merging into large urban agglomerations. Agricultural land between these towns is being lost forever.

Once a city takes over a farm, that land is lost to crops forever. One inch of topsoil takes thousands of years to develop, but the urban juggernaut grabs unchecked billions of inches of topsoil every year. It is true that urban development has been most intensive in India's best agricultural areas — the highest urban density can be found in the Indo-Gangetic plain. The government's decision to create vegetable farms around 10 cities in the country with the participation of local farmers can not only ensure vegetable supply, it can check the urban spread towards productive land. For example, the farms owned by influential people around Bijwasan village in Delhi have stopped the city's growth in that direction. But better and more enduring logic is needed if the urban demon is to be tamed.



People in slums provide many vital services for the rich. Job prospects are regularly communicated to kith and kin in the villages. (Mark Edwards/Earthscan)

have completed their schooling tend to seek better quality employment and can live with their families while they wait.

A very effective information network operates as regards the Calcutta labour market, maintaining close ties between the urban migrants and their home villages. The fact that Calcutta's slum population has not grown much in the last decade compared to Delhi and Bombay is related to the city's economic stagnation in the 1960 and 1970s, as well as to the effectiveness of this urban-rural information network. Significantly, migration from the eastern states to both Delhi and Bombay has increased in the last two decades. Obviously, the network told them that jobs were not available in Calcutta.

Nearly all studies show that the vast majority of slum dwellers migrate to particular cities because they have relatives, caste-fellows, or village friends already there who can help them. A study in Delhi found that 75 per cent of the squatters got jobs through such personal contacts. contacts.

## Migration as a strategy

The cities, compared with the villages, promise lighter work and higher and steadier wages. A study from Delhi states that the migrants average earnings over the year were two and a half times more than what they could earn in the rural areas. Many or most migrants see urban earnings as supplementing the rural, their urban stay as temporary, and their places of origin as their permanent homes. Thus, the migrants range from the seasonal or shuttle migrant coming for a few months to the permanent settler seeking a new way of life.

Seasonal or short term migration is usually resorted to by agricultural labourers, tenant farmers and small landholders during slack cultivation seasons. Many rural workers rely partly on farming and partly on some trade, craft, or service skills, and their nonagricultural occupations may take them periodically to neighbouring towns and cities.

Then there are 'target migrants': those who come with a specific purpose in mind, usually to earn a lumpsum of money for marriages or agricultural investment, and plan to return home once that is achieved. Target migrants may sometimes stay in the city for several years.

The most substantial section, however, are the 'working life migrants', who move to the cities for the rest of their working lives. But they keep in close touch with their places of origin, often leave part of their nuclear families there, and plan to retire at home.

The bhaiyas of Uttar Pradesh, as they are called in Bombay, epitomise the working life migrant. William Rowe has provided a very vivid portrait of the migrant bhaiya as seen from the vantage point of an Uttar Pradesh village called Senapur:

"It is 'recurrent' rather than 'permanent' because these men traditionally go to the city without their wives and families and return home annually for visits of a month or six weeks. With few exceptions these men view migration to the city as a temporary solution to economic problems and maintain their involvement in the network of personal relationships in the villages. In several cases they have worked for 25-30 years in Bombay which is 900 miles from the village .... Migrants to the city either remit or bring home with them all of their income beyond their minimal living expenses. This income has a differential function for the various families and caste communities who have deputed migrants to the city. Some men are pulled to the city because it is here that money can be earned to improve the family position at home (through purchase of additional land or farm animals or other capital expenditure).

"The other class of recurrent migrants includes those men who go to the city because there is poverty at home and because there is simply no opportunity locally to earn sufficient money for basic needs such as food, clothing and taxes .... A study of household budgets of both classes of recurrent migrants indicates that, regardless of what the causes may have been for the first migrant trip to the city, the family unit tends to perpetuate that relationship. A survey of items in the material culture makes it manifest that new items such as lanterns or bicycles enter the village first as 'luxury' goods brought home by the migrant, but that a decade later they have become 'necessities'. The whole equilibrium of families, especially those who are able to utilise city-earned income for capital expenditures, becomes dependent on having a migrant representative in the city."

Migration is a strategy on the part of peasant families to bring some of the city's wealth to the village. In the hill villages of north India, this economic order is aptly called the 'money-order economy'.

Slum life is usually thought as morally degenerate: broken families, crime, alcoholism. Studies prove most families are stable and hardworking, their children's welfare and success the prime goal. Marriages and festivals strengthen ties. Even the prostitutes work to educate their children. If men drink in inordinate numbers that is simply because drinking is the only way to relax.

Admittedly, life is hard. The day begins early and ends late as the workplace is often far away. People take up several jobs, housewives take up part-time jobs, to drive away the demon of insecurity. Sickness and disease, hazards in every slum, eat into earnings. But the hope that a better life is in the offing keeps the slum dwellers going, if not for themselves, then for their children.

### Slums as solutions

Given that kind of attitude to life, how do the slum dwellers themselves look at their unstable huts? The

## The Ruralisation of Urban India

Many medium-sized cities in the backward regions are declining from economic stagnation to positive regression. Their municipal administration and services are unable even to meet the needs of the natural increase in their population—let alone the increase because of migration. But the poverty in their rural periphery is even greater, which pushes more and more people into them. As jobs cannot be found for them in the modern, urban sectors, they continue with their rural occupations like animal husbandry and even agriculture. This has led over the last 20 years to large scale ruralisation of these medium-sized cities.

In many of these cities—in Uttar Pradesh, Bihar, Orissa, Madhya Pradesh and Rajasthan—even the so-called 'posh' localities are now crowded with goats, cows, buffaloes, poultry, and pigs. The wide roads, parks and open green areas are rapidly becoming cattle sheds and grazing grounds. In many poor and middle income localities, people and animals live under the same roof, as they do in the villages.

This is strikingly evident from R.P. Misra and H.N. Misra's recent study of the ruralisation of Allahabad, in the central region of Uttar Pradesh. The town's population has quadrupled during the last 80 years and stands today at 6.42 lakhs—a large part of this increase from 1961 onwards being due to the migration of the rural poor.

Employment in the city's manufacturing sector has declined from 24 per cent in 1961 to 9.2 per cent in 1981, there has been a doubling of employment in agricultural occupations in the same period: from 3.7 per cent in 1961 to nearly 7 per cent in 1981. The bulk of the city's population, moreover, continues to work in the tertiary sector—administration, educational institutions, commerce and petty trade. This tertiary sector accounted for 72 per cent employment in 1961 and the figure for 1981 stands at 84 per cent.

Every year thousands of unskilled labourers come from surrounding villages, most of them for a few months. They do all sorts of odd jobs such as rickshaw pulling, porters, shoe repairs, vegetable vending etc. A study in 1979-80 revealed that Allahabad's 10,850 cycle rickshaws provided employment—by a system of sharing by rotation—to 40,300 rickshaw pullers. Later, they come for good. Lacking any centralised milk or food supply system which can even partially meet the needs of the city's increasing population, Allahabad offers them a large, open, low income market for milk, vegetables, eggs and meat.

The results, as Misra and Misra describe it, is: "Cows, buffaloes, pigs and donkeys are a common sight in Allahabad. They are almost everywhere—in the collectorate, the high court, the hospital, the Civil Lines and near the bungalows in the 'posh' localities. Cowdung or excreta of cattle is found even on the most widely travelled roads and thoroughfares, let alone the lanes and bylanes of the city. Even the planned sections of Civil Lines are not spared by the roaming cattle and buffaloes. These animals add a new dimension to the growing informal sector of the city and are concentrated in certain sections of the city, all these parts have a slum-like appearance and remind one of a village."

In their detailed head-count of the current livestock population in five residential areas of the city—where municipal rules do not allow animals — Misra and Misra found their numbers ranging from 2,208 in the 'posh' Civil Lines to a maximum of 7,904 in the lower middle class Shiv Kuti neighbourhood. They also point out that more people mean more animals—to meet increased demand.

The livestock population grows faster than the human. Buffaloes increased from 2,758 in 1944 to 60,000 in 1982 and pigs from 614 to 80,000 in the same period, a rate of increase five times that of the humans. At the same time, there has been a fall in the growth rate of livestock in the rural areas around Allahabad.

The city's cows and buffaloes belong largely to the Yadavas, a scheduled caste community who earn their livelihood by selling milk. It all begins with a few buffaloes on the footpaths beside new roads. Gradually, almost the entire length of roadside is covered with lounging buffaloes and their excreta, as are all vacant spaces, whether children's parks or public land for buildings. Soon nobody except the animal owners will live here. The vacant houses are then rented to lower middle class people who cannot afford to pay high rents for a better environment.

This is only half the story of Allahabad's ruralisation. Donkeys are used by washerpeople to cart dairy products as well as clothes. Horses are used for pulling carts. Pigs, kept by the untouchable castes, provide meat and also function as quasi-scavengers. Cattle excreta is partially converted into dung cakes for cooking; the rest being left to be cleared by the municipal authorities—if they can.

Many of the poorer localities have an acute shortage of latrines, and children defecate in the open. The pigs then appear from time to time to clean this up, but release their own excreta in turn. In due course, even the muncipal authorities give up any pretence at cleaning up.

## Bypassed in Calcutta

Following the Supreme Court's stay against the eviction of pavement dwellers in Bombay, public opinion—at least among the intelligentsia—has veered around to recognising that these "wretched of the city" can't be wished out of sight by executive fiat.

The West Bengal government, even though a Left Front ministry, only pays lip service to the cause of protecting slum dwellers. During the past 2–3 years, this state government shows that it is no less repressive when it comes to evicting the labouring poor, whether hawkers, rickshaw pullers or squatters.

In 1983, Calcutta witnessed a sudden drive against "encroachments" in marginal land settlements where—unlike the "legalised" bustees—settlers are far less organised. There are 2 lakh such dwellers, who are poor workers. Nearly 10,000 squatters were evicted from various settlements that year. This was done without notice, in the presence of state ministers in some cases; the clearance was done in the name of "urban development."

One such action was against some eight to ten settlements on both sides of the recently built Eastern Metropolitan Bypass near Salt Lake. On June 18, all the huts extending 100 feet from the bypass were demolished. These residents were casual and domestic workers.

Some had come to the area in the early 'seventies as labourers to build a large sewer that runs along the bypass and later, the bypass itself. This obviously didn't give them any indemnity against eviction. The official reason for their removal was that some of the land was owned by the Calcutta Improvement Trust (CIT) and they have (or had) a scheme for its development.

The timing was extraordinary. Despite the Supreme Court interim ruling in the Bombay pavement dwellers' case that "evictions should not take place during the monsoons", the bypass operation took place at the very onset of the rains. One child died of exposure on the bypass. The harassed workers erected new huts wherever little space was vacant. No one went beyond a km or two, because they had to remain near the households that employed them. Some gradually returned to squat on private land beside the sites of their old homes but were evicted a second time within three weeks.

Two residents and the Association for the Protection of Democratic Rights filed a case on the ground that due process of law was not followed. Lawyers discovered that a 1962 law relating to the eviction of unauthorised occupants of land in West Bengal (and subsequent amendments) provided for 14 days' notice and the right of appeal to the collector. This little-known legislation, which was specifically created as an ordinance to facilitate eviction, also established the basis for a legal process.

The status quo was ordered after some hearings but the case hasn't come up for at least six months, which has made people sceptical about the value of legal action.

Another reason for the eviction which has subsequently emerged is that the CIT authorities are making available its land to a Jayashree Foundation to plant trees along the bypass. Investigations suggest that this is a Birla organisation, run by Jayashree Mohta, one of the Birla daughters. To expedite this, the CIT has fenced off this land with barbed wire. If the land was cleared to make way for a road, how is it that the space is now being used for a garden?

The people who are evicted are disorganised, as Unnayan, a local voluntary organisation, discovered when it began talking to them. However over the year, things have changed. A year later in June, at least one community of evictees has realised this contradiction of "tree-gardens or people"—and led by a woman have physically blocked the fencing. The CIT has retired apparently hurt.

There were yet other obstacles, which they least expected. The United Council of Refugee Committees UCRC, a CPM-affiliated organisation, which had earlier collected chanda (subscriptions) from many of them against receipts, was later unwilling to vouch for them and supply proof of residence. Local political mastaans threatened the people when they were preparing posters to publicly display their condition. The local MLA would not do more than forward their demands for proper settlement to the concerned minister, despite the fact that both belong to the same party. Above all, there is disunity among evictees themselves.

The principle of non-discrimination between authorised or unauthorised settlements has been asserted in the Planning Commission's October 1983 report on 'Slum Improvement and Shelter for the Urban Poor'. In Calcutta, slum improvement and provision of amenities is only for slums on private land. It seems to be an unwritten understanding between departments that no improvements will be made for the people living on public lands. The bypass dwellers have lived for almost a generation without basic amenities, in the city that has the world's largest and most publicised slum improvement programme.

The wave of evictions and arrests in June and July led to a counterwave of protests, by a number of people and organisations including Unnayan and in response the Minister for Urban Development, Prasanta Sur, called a meeting of voluntary organisations in July 1983. After a fairly frank exchange of views—where almost all organisations condemned the evictions—the minister announced that anybody affected by development projects, would be rehabilitated. He then offered land and services for any serious proposals he received. In December 1983, Unnayan worked out a detailed proposal with the residents of the bypass to enable them to settle down with secure tenure to earn their livelihoods and collectively own and manage their settlements.

Finally in August 1984, after many reminders, the minister agreed to meet the evictees and Unnayan to discuss the scheme. He said the land proposed was "not available" but that he would "try his best" to arrange for land to be made available . . . . A year later the struggle continues.

"The experience of the bypass is that the institutions of the State: the courts, the government and the political parties, are failing the people. But gradually some of the people are becoming aware and getting organised in their fight together," says Unnyan.

## Delhi's Anti-People Bills

Even as the government talks about slum upgrading as a national policy, four bills passed by the parliament in May 1984 make the eviction of slum dwellers in Delhi and its environs easier. More specifically, they attempt to make what are now civil offences—encroachment on public land and putting up unauthorised construction—a criminal offence.

The Acts are amendments to the Delhi Development Act, 1957; Delhi Municipal Corporation Act, 1957; Public Premises (Eviction of Unauthorised Occupants) Act, 1971 and Punjab Municipal (New Delhi) Act, 1911. They empower high officials of the Delhi Development Authority, Municipal Corporation of Delhi and the New Delhi Municipal Corporation to have such "offenders" arrested without a warrant and without bail.

The new "crime" of unlawful occupation of any public premises can attract a six-month jail sentence or a Rs 5,000 fine or both. What is more, the existing right of appeal to the district courts, and the possibility of obtaining a stay, are removed. Appeal can only be made to a tribunal, the powers of which are limited. The ultimate authority in an appeal is the lieutenant governor, who is part of the executive and not the judiciary. Ever since the emergency, the incumbent of this post has always bent to the political will of the ruling party.

The civic authorities, who are even as it is armed with formidable eviction powers, can now seal an unauthorised construction even before demolition orders have been passed. They can swoop down on jhuggi and jhonpri dwellers (slum dwellers) without notice and seize and remove whatever building materials and personal possessions they have: in other words, deprive the poorest citizens of the country's capital of the meagre belongings they have put together through sheer hard work.

The proposed amendments thus dispossess those who are already marginalised of their residual rights. They invest enormous power in the hands of the administrators who can, by merely complaining to the police initiate demolition and order arrest of slum dwellers. This opens the door wide to abuse of such authority, without the right of recourse to legal appeal.

The inspiration for these bills comes from the Maharashtra government which, by passing an ordinance in 1983, made unauthorised development a non-bailable, cognisable offence. This has subsequently been made an Act. The penalty is three years' imprisonment, while obstruction of demolition of itself can send the offender to jail for a year or invite a fine of Rs 1,000. This severe ordinance followed on the heels of the state government's efforts to clear certain slums and pavement dwellers in 1982, which was stayed by the Supreme Court. Similar legislation may be passed in Gujarat: the standing committee of Surat Municipal Corporation passed a resolution in October 1983 requesting the state authorities to promulgate an ordinance for the eradication of slums and for providing deterrent punishment for unauthorised construction.

A Jhuggi Jhonpri Nivasi Adhikar Samiti (Committee to protect rights of slum dwellers) has been formed in Delhi by leading civil liberties organisations and social activists to agitate against the bills. As the members emphasise, some of the objects of the proposed amendments—like the control of land-grabbing by the rich—may sound laudable, but the brunt will fall on the 10 lakh slum dwellers who have no easy way of resisting such strong-arm tactics by the Delhi administration.

## The Right to Life

On July 23, 1981, some 10,000 pavement and slum dwellers of Bombay were herded into state transport buses, driven hundreds of kilometres outside the city to other towns and released. The non-Maharashtrians were handed tickets to towns in other states. Their huts were demolished and their possessions dumped into Bombay Municipal Corporation (BMC) rubbish trucks.

The same day, the Bombay High Court admitted a writ petition by the People's Union for Civil Liberties (PUCL) asking for a stay on the deportation, which was granted. During the hearing, the government even conceded that deportation was illegal and unconstitutional and gave an undertaking not to deport any pavement or slum dwellers.

The PUCL petition was disposed off on August 14, 1981. The PUCL then filed a comprehensive petition in the Supreme Court, which stopped short of claiming the fundamental right to live on the pavement. However, journalist Olga Tellis argued for such a right in a separate petition to the court.

The PUCL pointed out that it was the fault of the Maharashtra government and the BMC that over half ofGreater Bombay's population of 8.75 million lived in slums.

The city's hutment dwellers contribute enormously to Bombay's economy, but are forced to live in appalling conditions because of miserably low wages. And this when land is available: Greater Bombay's gross area is 43,000 hectares and estimates of vacant land vary between 3,000 hectares and 10,000 hectares. Taking an average of five persons per unit—the Maharashtra government's own figure—the 4.7 million hutment dwellers would occupy about 9 lakh dwellings or, at 15 sq m a unit, about 1,350 hectares, well within the amount of vacant land. Thus, as the problem was not technical, it could only have been created by mismanagement.

The cut and thrust of debate before a constitutional bench of the Supreme Court was interesting. BMC counsel remarked once that "pavement dwellers are all anti-social elements, really criminals", the BMC and the Government of Maharashtra (GOM) refused to produce a list of vacant sites as directed by the court. BMC and GOM counsels argued that: there was not sufficient vacant land; the hutment dwellers were not prepared to shift to alternative sites unless these were close to their place of work; in any case, they would sell any alternative sites provided and return to the old ones; the authorities had agreed to give alternative sites to hutment dwellers covered by the 1976 census. They took the stand that they were not prepared to find a solution until the hutment dwellers satisfied the court about legal rights.

The PUCL's counter-arguments were sharp: there were at least 6,000 hectares of vacant land, going by an official survey; another study showed that hutment dwellers were not at all reluctant to move to alternative sites; the GOM's plan to provide alternative sites to slum dwellers covered by the 1976 slum census was half-baked since that census covered only state government lands, not Central government, private or the pavements.

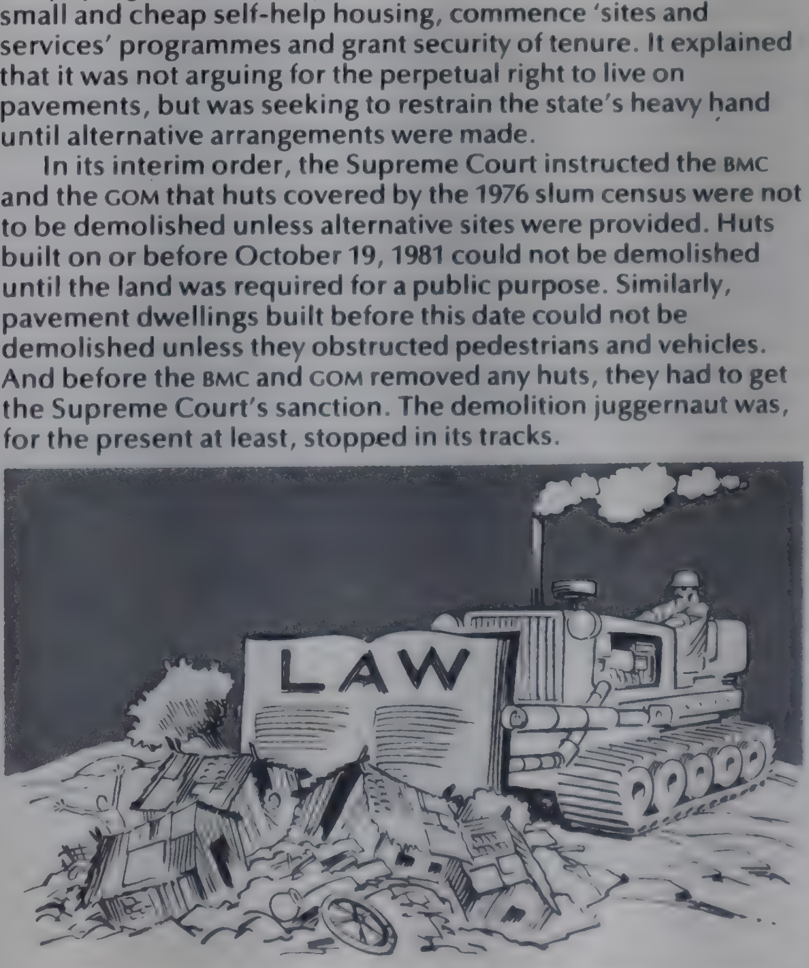
The other side was obdurate. They claimed that the hutment dwellers had left Bombay voluntarily; they were anti-social elements and health hazards; the police had the power to remove obstructions; there was no vacant land; finally, no fundamental right could be claimed by hutment dwellers as they themselves had committed a wrong by encroaching upon public land.

The PUCL came back by saying that it was a deplorable travesty to argue that the hutment dwellers had left Bombay voluntarily—people died, families were separated and their belongings wantonly destroyed. Despite the undertaking not to deport any more, the BMC and GOM with their continuing demolitions would force hutment dwellers to leave, or set up home elsewhere in the city, hounded periodically by demolition squads.

The PUCL further argued that the BMC turned a blind eye to similar breaches of specifications and regulations committed by influential building contractors; as for health hazards, the BMC had failed in its statutory duty to provide adequate sewers, latrines and water to hutment dwellers. It stated that its arguments were founded on the right to life enshrined in Article 21 of the Constitution, which means more than just physical survival but includes the right to live with human dignity along with the necessities—food, clothing, shelter—and the chance to interact with other humans. Driving the hutment dwellers away would deprive them of the right to life as they would ultimately be driven to starvation and death.

The PUCL wanted the state to release hoarded vacant land, adopt pragmatic building regulations to aid construction of small and cheap self-help housing, commence 'sites and services' programmes and grant security of tenure. It explained that it was not arguing for the perpetual right to live on pavements, but was seeking to restrain the state's heavy hand until alternative arrangements were made.

In its interim order, the Supreme Court instructed the BMC and the GOM that huts covered by the 1976 slum census were not to be demolished unless alternative sites were provided. Huts built on or before October 19, 1981 could not be demolished until the land was required for a public purpose. Similarly, pavement dwellings built before this date could not be demolished unless they obstructed pedestrians and vehicles. And before the BMC and GOM removed any huts, they had to get the Supreme Court's sanction. The demolition juggernaut was, for the present at least, stopped in its tracks.



startling answer turned up by studies is that they do not really think it is such a terrible problem. The poor city-bound migrants come from mud huts in the villages and expect little more, at least upon arrival. Village water supplies are neither more accessible nor much purer than those of the city. Lavatories and waste disposal systems are usually non-existent back home.

A second factor is the correlation between caste religious status and housing quality. In Hyderabad, for instance, 59 per cent of slum dwellers are estimated to be from the scheduled castes and tribes, and 34 per cent are Muslims. In many parts of India, especially in the villages, prior to Independence Harijans were forbidden to build solid dwellings. They were forced to live in huts and forbidden to use common village wells. In that context, the Harijans in cities may not feel so deprived today as outside observers might imagine.

The urban poor can therefore tolerate slum conditions better than the urban rich. On occasions, when government housing programmes have allowed other housing choices to slum dwellers, many of them have sold out their official houses and returned to their original slums. Research and interviews with groups of squatters conducted by Meera Bapat in Pune's slum clearly indicate that their principal concern is employment, housing is second. They seek the crowded, inner-city locations because the chances of finding jobs, especially the unskilled, casual jobs for which they are most eligible, are so much higher in the central business district than anywhere else.

In a national survey of settlement patterns of the urban poor, Rakesh Mohan (housing expert and consultant Planning Commission) has concisely summarised the underlying logic and evolving priorities: "The poorest (for example fresh migrants) are mainly interested in location. Being near job markets saves on transport costs. In their highly uncertain situation the only security they are interested in is job security. Their meagre income only allows for food consumption and other bare essentials in a kind of lexicographic ordering. The only amenity they need is space for sleeping. The next group, with a reasonably stable income but still not well-off, is interested in security of tenure. A temporary job loss does not then mean displacement of residence as well. They are also more interested in space than amenities and are willing to pay for it. Finally the richest, low income group is more interested in amenities, having a stable income and subsistence essentials. Electricity, plumbing, well-designed housing, and recreation then become important and will be demanded by this group."

**Waste building materials make up a slum in Calcutta. (Studio Camellia)**

But central land is most likely to be owned either privately or by the government, squeezing the squatter out. The slum dweller sees the makeshift hut, often on encroached land, as a solution rather than a problem. It may be ugly, insanitary, illegal, but it does nevertheless serve as a shelter.

## The housing crisis

There are thus two major aspects of the housing crisis. On the one hand, the failure of the government to view urban housing as a multidimensional process which involves making provision for several other needs apart from physical shelter as a result, after 35 years of governmental planning. There is a colossal housing and infrastructural shortage which has steadily accumulated over the years and is now as the Planning Commission itself admits, beyond solution. On the other hand, the urban poor have solved this problem in their own desperate manner, by building clusters of hutments and shanties wherever and however they can. The resulting slums barring a South African type authoritarian 'solution' are here to stay.

Given this grim scenario, Indians should perhaps learn to live with slums. Planners are also beginning to realise that squatters are economically valuable citizens who add to the gross national product by constructing their own shelter, no matter how makeshift, which saves the government a considerable amount of money. That squatters are upwardly mobile citizens in search of economic opportunity and have demonstrated high levels of enterprise, tenacity, and ability to suffer acute hardships; that the informal sector in which a majority of the slum dwellers are economically active contributes significantly to the city's overall economic growth; and that they should be helped and not hindered.

What can be done is to upgrade, not demolish, most existing slums, and move the remaining squatters and pavement dwellers to reasonably well-located vacant lands as part of a site-and-services scheme. In at least a few cities, local governments are attempting to act on these views and help the urban poor settle down. Ahmedabad, Calcutta, Madras and Hyderabad are experimenting with slum upgrading programmes. There are two basic elements: security of tenure and improvement of the physical conditions and basic amenities. The experience of these cities merit attention both as examples of what is possible with all the constraints, and as alternatives to the essentially demolition and eviction-oriented policies of Bombay and Delhi.

### Ahmedabad

The squatter relocation project in Vasna suburb combines self-help with government assistance. With about 2.25 million people in the metropolitan region, Ahmedabad has about 7000 slums and squatter settlements, housing nearly 415,000 people. After the 1973 floods in the city's Sabarmati river which washed away thousands of squatter home, the Ahmedabad Study Action Group (ASAG), a voluntary, interdisciplinary organisation of various professionals, submitted to the municipal authorities an integrated plan for moving the displaced squatters to a new suburban settlement. Their plan involved building them new homes, and providing social and economic welfare assistance to raise their living standards and their ability to participate in the city's economic activity. A constant refrain of the ASAG proposals was that 'slums are people, not places'.

The state government was eventually pushed into allocating 43 acres for a new settlement located about 7 km from the city centre. TheAhmedabad municipality agreed to extend piped water, sewerage, street lighting, roads, and community facilities such as schools, shops and health centers. HUDCO (Housing and Urban Development Corporation) approved low interest 20 years loans to the occupants which was followed by a state subsidy of Rs 700 per family and another Rs 400 per family was provided by Oxfam. A majority of the flood dislocated squatters agreed to move to Vasna.

The results, nine years after the first bricks were laid in May 1974, have, however, been mixed. Problems of quality of shelter construction, distance from the city and employment sites, an artificial juxtaposition of diverse ethnic/caste groups, incomplete city drainage facilities, differing economic and social priorities among the squatters themselves, and political corruption have marred the project. Many of the original squatters have returned to locations closer to the city centre. Other people have moved in and the neighbourhood now is ethnically more homogenous: Muslims now form 75 per cent of its residents. Despite these problems and changes, however, Vasna remains a very interesting experiment.

### Calcutta

In 1971 the Calcutta Metropolitan Development Authority (CMDA) started the country's most ambitious slum upgrading programme to cover in stages by 1984 the city's slum population of approximately three million. By 1980 the total slum population had risen to 2.7 million crammed into some 3,000 separate slums. Calcutta's planners have tried to improve the existing slum environment and make it more livable.

The CMDA has focussed on six areas : conversion of existing service latrines to sanitary latrines and the construction of a new toilet for every 25 persons; potable water tap connection to individual huts or for every 100

### Slum Sickness

The little data available from India's major cities clearly indicates that the most common illnesses in slums are respiratory diseases, gastro-intestinal disorders. skin diseases, worms, ear, nose and throat (ENT) infections, and tuberculosis. Venereal diseases are found mostly among migrant men who have left their wives behind in the village.

In Delhi, the Town and Country Planning Organisation (TCPO) survey of 1975 for four squatter settlements found that 56 per cent of the households had suffered from malaria within the previous year, and 27 per cent from diarrhoea.

Calcutta's slums appear to be the sickliest. A recent survey by the Calcutta Metropolitan Development Authority (CMDA) of an upgraded basti found that 76.4 per cent of the household reporteds respiratory diseases within the previous year, 65.5 per cent reported gastro-intestinal disorders, 62.4 per cent diseases of the mouth, teeth and gums, 35 per cent viral infections, 17 per cent tuberculosis, 15.6 per cent heart diseases, 16 per cent skin diseases, and 14 per cent ENT diseases.

Significantly, a nearby non-slum neighbourhood reported an almost identical incidence of gastro-intestinal illnesses, a fact attributed by the CMDA to the improvements made in the slum's sanitation and water supply. But the incidence is extremely high for both areas.

However, the incidence of tuberculosis in the basti was 10 times more than that in the other area, viral infections 2.5 times greater, and skin disease twice as high. The greater incidence of the highly infectious diseases in the basti would seem to stem from the appalling living conditions. The majority of these illnesses were chronic and the average duration of illness per sick person in the basti area was considerably longer than that in the non-slum area. And this is an upgraded slum.

Slum dwellers do not consult traditional practitioners or quacks, as popularly believed; allopathic doctors are most likely to be consulted. Unfortunately, they do not generally seek treatment until home remedies have failed and the disease has reached an acute stage. Moreover, since hospital consultations are not easily accessible and medicines very expensive, they take medicines only until the symptoms go away and as a result, most ailments become chronic.

Consequently, the poor spend a far greater proportion of their meagre income on medical treatment than the middle or upper classes. The Calcutta study found that even though the basti people spent less on medical treatment than those living in the nearby non-slum area (Rs 14 and Rs 20 per month respectively), this was 5.3 per cent of their income as opposed to their more affluent neighbours for whom Rs 20 was less than 3 per cent of monthly income.

R.L. Chopra/Indian Express

Studies also show that doctors who treat slum residents do not usually understand the environmental conditions in which they live and tend to blame their poor health only on the food. Malnutrition certainly contributes to high rates of morbidity, especially among small children, but the grossly inadequate supply of clean water, the crowding and congestion, and the near total lack of sanitary facilities do their bit to help disease get the upper hand in slums.

persons with an average water supply of 90 litres per head; surface drainage facilities through underground conduits connected to an underground sewer system wherever available, or open surface drains discharging into the nearest open drainage channels; paving of roads, streets, and pathways; basic security provided by lighting of streets and pathways; and miscellaneous facilities such as garbage vats, dustbins, and bathing facilities at suitable locations.

These basic civic services cost Rs 120 per person between 1971 and 1973, rising to Rs 150 later. As the programme spread away from areas with basic infrastucture, the cost rose to Rs 350 as totally new facilities had to be installed. By 1981, some 1.9 million slum inhabitants had been serviced at a total cost of Rs 25 crore .

"Implementing the programme was a huge technological challenge," says M.S. Moitra, director general (operations) of the CMDA and the brain behind the project. For instance, as most slums were not served by the city systems, 'captive' sewer systems had to be designed for entire slums, by which the slums sewage was collected by interconnecting pipes and then dumped into the nearest city sewer. Cheap latrines were bulk manufactured.

Unfortunately, the problems remains: some 70 per cent of the assets created are out of order at any given time. Thousands of latrines are choked with excreta and garbage. Taps stay dry. Drains overflow after slight rain. Uncovered manholes are safety hazards. Street lights are without power. the blocked latrines and leaking sewer pipes have sometimes led to a spate of cholera and diarrhoea in recent years.

**Slums are organic communities with strong work and human relationships. (Mark Edwards/Earthscan)**

"It would cost only Rs 3 per household per year to maintain these services," says Moitra. "The existing system of entrusting contractors with responsibility for maintaining services is inefficient and costly." A senior CMDA planner agrees: "The CMDA has spent Rs 25 crore on a Rs 5 crore job. The rest of the money has simply been siphoned off by contractors." A World Bank mission even took note of this recently. Proposals to involve the community in maintenance have not been welcomed, in fear that the politicians would lose their clout.

Another aspect of the Calcutta scheme is that it has not provided security of tenure. Unlike slums in most other cities, Calcutta's slums are on privately-owned land. Long ago, the zamindars leased vast tracts of fallow land around the city to a set of middlemen called thika tenants (thika means contract in Bengali). The thika tenants built shacks and hired them out to migrant factory workers. Today the landlords and the thika tenants constitute a powerful interest group in the West Bengal politics.

### Madras

In 1971, the Tamil Nadu Slum Clearance Board (TNSCB) decided to resettle all hutment slum dwellers of Madras city — about 0.74 million people at that time — in pucca tenements to be constructed with public funds by 1977. By 1978, instead of the 1,64,000 tenements planned at an estimated cost of Rs 164 crore , barely 23,000 were actually completed at a cost of Rs 25 crore .

The authorities shifted their emphasis to upgradation from 1977 onwards, encouraged by a World Bank loan. The two major schemes are the Environmental Improvement Scheme (EIS) and the World Bank Improvement Scheme (WBIS).

Under the EIS, 293 slums were covered to benefit about 1.05 lakh households at an estimated cost of Rs 5.12 crore . The local authorities soon realised that the funds would not provide adequate services for all the beneficiary households. The amount spent varied considerably, less than Rs 100 per household in some slums to Rs 1,300 per household in others. The average expenditure was about Rs 500 per household.

A survey of the actual improvements in 23 slums was carried out in 1980 by the Operations Research Group (ORG), an independent research unit, which found that less than Rs 625 per household had actually been spent in 90 per cent of the slums. The report contrasts the case of VOC Nagar where expenditure was the highest, Rs 1300 per household, with Karunanidhi Nagar, where it was Rs 500 per household. While VOC Nagar's 490 households had been provided with baths and lavatories, stormwater drains, roads and wells, their less favoured counterparts in Karunanidhi Nagar were provided only with stormwater drains and roads.

Maintenance has been neglected. The 1980 survey of VOC Nagar found "the baths, latrines and wells under disuse, the roads broken and full of ditches and stormwater drains in no condition to clear stormwater". "Of the households contacted, nobody today finds any use for any of the above facilities," says the report. The water from the wells, say the slum dwellers, is filthy and dirty and without water being available, the baths and latrines cannot be used either. Their old lifestyle of relieving themselves and bathing in open spaces is no worse.

Karunanidhi Nagar was just as bad if not a little worse. "In fact, stormwater drains at some parts have even ceased to exist and at other parts mud and sand have totally filled them up. The hard surface of the road is barely visible at places and at some places ditches have formed which contain water and dirt" the ORG survey found.

**Slum population growth in some major Indian cities**

| Metropolitan city | Year | Population of City (millions) | Slum Population (millions) | % of Slum Population |
|---|---|---|---|---|
| Calcutta | 1974 | 3.19 | 1.44 | 45.00 |
| | 1981 | 9.16 | 3.24 | 35.35 |
| Greater Bombay | 1976 | 7.94 | 3.25 | 41.00 |
| | 1981 | 8.23 | 4.20 | 51.03 |
| Delhi | 1977 | 5.29 | 1.32 | 25.00 |
| | 1981 | 5.71 | 3.02 | 53.00 |
| Madras | 1977 | 2.47 | 0.99 | 40.09 |
| | 1981 | 4.27 | 1.36 | 31.86 |
| Hyderabad | 1977 | 1.99 | 0.4 | 20.00 |
| | 1981 | 2.52 | 0.54 | 21.28 |
| Ahmedabad | 1976 | 1.89 | 0.42 | 22.00 |
| | 1981 | 2.51 | 0.66 | 26.16 |
| Kanpur | 1976 | 1.33 | 0.56 | 41.98 |
| | 1981 | 1.68 | 0.68 | 40.34 |

Source: "Task Forces on Housing and Urban Development—Vol. IV", Planning Commission

The maintenance of TNSCB facilities was to be the responsibility of the Madras Municipal Corporation. But such a clear division did not materialise. The result, concludes the 1980 survey, "which was observed at the slum level was that though occasionally MMC staff would come for cleaning roads in the areas under their jurisdiction, they would not clean or look to the upkeep of the facilities created by the TNSCB (in the same area)." Within four years of provision of services, the entire investment had come to nought.

The WBIS seems to be relatively better planned and more comprehensive. Part of the multisectoral Madras Urban Development Project-I taken up in 1977-78 under the coordination of the Madras Metropolitan Development Authority (MMDA), the scheme, whose implementation is the responsibility of the TNSCB, is intended to benefit 30,000 households in 36 slums at an average cost of Rs 1,300 per family. Unlike the EIS the WBIS has standard guidelines, the standard being uniform for all slums. In addition to routine provisions, there is provision for primary and secondary schools, plots for children's creches and sheds providing work space for suitable cottage industries. Preliminary reports indicate that this upgrading project has been significantly more successful than the previous one.

In addition to the slum upgrading scheme, there is also a sites and services scheme in Madras. About 27,000 families are to be helped to put up their own shelters on new, serviced sites by 1985. About 70 per cent will be from the

## Slum City

Dharavi, Bombay's and Asia's largest slum, sprawls over 4.5 sq km of prime land in central Bombay. This prime real estate, where huts today fetch a price of Rs 95,000, was originally creek land, where families of potters and tanners—the Bandra Slaughter House, then existing, was close by—had pitched their shanties. They were soon followed by garage owners, rag pickers and scrap dealers and others who brought in their wake conmen, goondas, thugs and slumlords.

The encroachers originally occupied private land, but by and by took over municipal as well as government-owned land. Today, 2.5 sq km of Dharavi land belongs to the corporation, and one kilometre each to private landowners and the government. Unofficial guesstimates put the number of shanties, pucca and semi-pucca constructions at over 65,000. The area has a stable population of over 3 lakhs and a floating population of over one lakh, which means that a substantial 4 per cent of Bombay lives here.

The slum is a melting pot: 67 per cent of the population is Hindu, 26 per cent Muslim and the remaining 7 per cent divided among the Christians, Sikhs and other minority groups. Though some of Dharavi's 44 colonies are divided communitywise, most are grouped together by states.

But sizes vary from 150 sq ft huts to over 500 sq ft. Income groups range from Rs 400—about 60 per cent make this much—to those whose earnings could be pegged at anywhere between Rs 500 and Rs 1,500 per month and even more. Besides shop-owners, a large chunk of Dharavi's population is in government service.

It is loosely estimated that over five persons live in a hut, without counting the 'guests' in 'permanent' residence. In addition, the slum dwellers tend to hide their kids, whenever a survey is undertaken, because they still think that they will be forcibly sterilised. The average per hut might be as much as eight persons.

Although there are four municipal schools in the area, only 7 per cent of the children go to school, while a fraction attend the balwadi. There are plans to construct two more such balwadis. More than Rs 80 lakhs was spent by the corporation in Dharavi during 1982-83 to provide basic amenities: eight clinics, two vocational guidance centres, one four-storeyed building consisting of a maternity home, a primary health centre, family welfare and nutritional departments. There are two playgrounds and also two cemeteries for two communities.

But, toilets and taps are in short supply: there is one tap for 320 people and one toilet for over 300. Fights over water are daily affairs. Squatting by men, women and children outside toilets, in open fields and along the streets is a common sight.

Despite the discomfort, the residents of Dharavi would not like to move elsewhere, for example, to other suburbs like Dahisar and Bhayander, says tannery owner Fazal Mahmood: "We have a lot of facilities like easy bus and train travel and moreover I am not afraid to run my business here. We are from Bihar, and so are my Hindu brethren. We have decided to bury communal hatchets and think that we should not let religion interfere with our business or everyday life." Rickshaw driver Raja Waingankar adds: "I usually make Rs 100 a day operating from Dharavi to the railway station. I am happy staying here, but I wish we could have a few more taps and toilets." The philosophy of the slum city can be summed up in a typical Dharavi comment: "Zindagi kya hai yaar, ek bada khadda hi to hai, jisme hum sab ko ghuss ke rahena hai (what is life but a huge gutter in which we are all stuck)."

But sometimes even big people enter these 'gutters'. In 1983, in response to opposition leader Chandra Sekhar's march across the country, Congress (I) MP Rajiv Gandhi walked through the muck of Dharavi. Commenting on the control of gangsters over this slum city, Sheela Barse recently wrote in the Indian Express: "It is said that Rajiv Gandhi's famous padyatra through Dharavi would never have materialised without (local crime boss) Varadarajanar M. Mudaliar's support."

## Water Torture

Every morning the suburban station of Saidapet in Madras witnesses a strange sight. At 4.30 a m , as the first suburban train pulls into the station a hundred-odd people rush off with their pots and pails to fill them with water from the nearby public tap. With the same haste they rush to catch the train on its return journey. This water transport operation goes on until 8 a m by which time the trains are packed with office-goers. By then, at least 1,200 pots of water have been taken to St Thomas Mount, a perennially thirsty , water starved part of Madras.

Even in the normal run of things, the water supply situation in Madras is desperate. Each resident gets barely half the minimum recommended amount of 125 litres per day. Chaotic scenes at public taps and at leaks in the supply mains are routine. People in the slums get into queues as early as 2 a m to collect water. And the water supplied is unfit for human consumption, according to the chief water analyst of Tamil Nadu.

Madras gets about 220 million litres daily from three reservoirs—Red Hills (near Saidapet), Cholavaram and Poondi. In the northern part of the city, another 45 million litres are pumped out of the ground to meet industrial demand. Insufficient rainfall in 1980 and 1981 reduced the water level in the reservoirs to 105 billion litres in January 1982, against a total capacity of 190 billion litres. With a poor monsoon in 1982, this level fell further to 36 billion litres in January 1983, a mere 72-day supply. A month later, Metrowater, the city's water supply agency, restricted supply to alternate days. "Our priority is now to see that every citizen of Madras gets about two buckets (20 litres) of filtered water every day," stated T.A.K. Dewan Mohammed, managing director of Metrowater.

The summer of 1983 was a gruelling one. As far back as 1981, slum dwellers had shuttled from one part of Madras to another by train to collect their daily water ration. Now they slept by roadside taps and pumps. Said one: "I used to earn Rs 5 a day as a labourer. Now I am busy all day fetching water and I cannot go out to earn my living." Local toughs, often with political patronage, rationed water or policed mobs at public taps, collecting a fee of 10 paise a vessel.

Except for a fortunate few who had their own wells most residents depended on Metrowater tankers. Queues became routine. The daily bath became a luxury. People ate goods that required less water for cooking. Those who could afford to pay, bought water at 30 paise a bucket or more, from enterprising youths. "Selling water is a booming business. I make Rs 50 a day this way," said a young man, who usually earned Rs 25 as a mason.

Private trade in water flourished. Truck and tanker owners brought water from coastal areas to supply bulk consumers like restaurants, hotels, theatres, industrial establishments, educational institutions and hospitals. The price of one 8,000-litre truckload, shot up from Rs 80 in July 1982 to Rs 250 in April 1983. At one time, Metrowater alone spent Rs 60,000 daily to transport 6 million litres.

Industrial establishments were doubly hit by water shortage and power cuts—from 45 per cent to 100 per cent, due to a fall in hydroelectric power generation. The production losses, by one estimate, were about Rs 70 million to Rs 80 million a day.

The desperate state government, at various times, invited a musician, a magician and an American cloud-seeding company to produce rain. The (AIDMK) Chief Minister M.G. Ramachandran, tried to pressurise neighbouring Karnataka to release water from the Cauvery river. The Congress (I) government at the Centre responded with its own gimmick: it ordered the Railway Ministery to transport water to Madras. This yielded 3 million litres a day for a while, at a daily cost of Rs 3 lakh .

Metrowater installed thousands of handpumps, sank over 2,000 tubewells and dug 132 deep borewells. It also dug three giant wells near the main reservoirs to tap subsoil water. These measures enabled it to supply 160 million litres to 180 million litres every other day after February 1983. Since individual citizens had also dug hundreds of tubewells, several shallow wells belonging to poorer people dried up because of overexploitation of the water table.

The southwest monsoon finally brought relief after July 1983. But the respite was only temporary. The city's water resources desperately need to be augmented. The rains have yet to recharge the excessive withdrawal of groundwater during the drought. Knowledgeable people fear that Metrowater's crash programme to tap the surrounding groundwater belt may either exhaust this source of freshwater or pollute it with saline seawater.

As a long term solution, the Tamil Nadu government has signed an accord with the government of neighbouring Andhra Pradesh to obtain 437 billion litres of water from the Srisailam dam through a 480-km canal. This project is estimated to cost Rs 7,60 crore and is planned to meet the city's requirement of 1,300 million litres a day by the 21st century. But the first phase alone will take seven to eight years to complete and Tamil Nadu will be hard-pressed to find the money. An integrated approach including conservation, recycling by bulk consumers, digging ponds to store rainwater and afforestation could provide a less expensive alternative.

Raghavendra Rao/India Today

urban poor. The financial resources are to be raised by selling the remaining 30 per cent of the sites to shopping complexes, and to low income and middle income group householders. About 50 per cent of the total outlay of Rs 40 crore is a World Bank loan, with the Tamil Nadu government funding the rest. The government's contribution, advanced to the implementing agency, the Tamil Nadu Housing Board, will be a revolving fund for future programmes of this type

The sites are to be handed over with utility services and partial construction: the allotee is then expected to build a home to suit personal needs and income. A loan of Rs 3,000 for each household is to be arranged either from nationalised banks or HUDCO. Three types of sites are on offer. An area of 429 sq ft with only a lavatory and bathroom already built; and area of 500 sq ft, with two completed rooms in addition to the lavatory and the bathroom. The allotees take the site on hire purchase on monthly instalments ranging from Rs 22 to Rs 30 for the first, Rs 33 to Rs 80 for the second and Rs 70 to Rs 120 for the third. They are allowed 20 years for repayment. Two of the five settlements under this scheme have been completed.

The scheme is really aimed at the better off urban poor, who can pay regular instalments, building expenses and municipal taxes. The middle class which takes 30 per cent of the sites could raise the settlement's property value and coerce and cajole their poor neighbours to sell at a profit and move back to the slums. Admittedly the urban poor are not so poor as they seem — small -scale shopkeepers and skilled artisans at the top of the scale earn Rs 800 to Rs 1,000 a month while casual labourers and hawkers make Rs 200 to Rs 300 a month at the other end.

Upgrading programmes clearly tend to reach lower income groups among the urban poor. An outlay of Rs 4 crore was required to benefit 30,000 households for upgrading 36 slums in Madras, while a sites and services scheme benefiting 27,000 households in the same city required Rs 40 crore .

## Hyderabad

Hyderabad's population in 1981 was estimated at 2.2 million of which approximately 500,000 live in slums. The city's slum dwellers have participated in an urban community development (UCD) project which covered barely 4,000 people in nine slums in 1967 but embraced 400,000 people in 459 slums by 1981. It was adopted in 1974 by the Hyderabad Municipal Corporation as its main policy for slums, and over the period 1974-84 has proved to be a highly successful slum upgrading programme which now covers over 81 per cent of the city's slum population.

Hyderabad was one of 20 cities along with Ahmedabad, Baroda, Calcutta and others selected in 1967 for a Central government sponsored series of pilot projects in urban community development. But it is only in Hyderabad that progress was made in converting a successful pilot project to a relatively successful city-wide programme. The main components have been emphasis on self-help in bringing about and maintaining improved civic amenities; granting of land tenure to the slum residents by the municipal corporation; and a flexible, responsive and dedicated approach on the part of the project organisers.

Self help is basic to the development process. Of course, development planners expect more self-help from the poor than from, say, the middle class, who are not asked to improve roads or clear garbage. Fortunately, in the Hyderabad project, basic physical amenities have been provided through coordination between project staff and the corporation's engineering department.

**Coverage of slum upgrading schemes in Hyderabad**

| Year | Total No. of Slums | Total slum population | % of slum population covered |
|---|---|---|---|
| 1967 | 94 | 100,000 | 4.06 |
| 1976 | 300 | 300,000 | 20.00 |
| 1981 | 470 | 500,000 | 81.04 |

The slum dwellers simply determine the location of taps and latrines, the width of the paved passages and so on. They have contributed in greater measure, with labour and money to improve housing and build community centres — each household pays upto 75 per cent of rebuilding costs of their home through bank loans. The slum dwellers also contribute to community centre activities: balwadis (creches), adult literacy clases, and cottage industry cooperatives.

What made this high degree of involvement and self-help possible was the granting of ownership rights (pattas) to each household for their plot. This not only assured the slum dwellers of the benefits of whatever they invested in rebuilding their homes, it also made it feasible for the city's banks to grant them loans by holding their pattas as mortgage. Between 1977 and 1983 the Andhra Pradesh government gave pattas to 13,000 additional households, which enabled 13,000 new houses to be built in various low income areas.

The resident families are far more concerned with maintenance than they would be if the government had built the houses and handed them over. Moreover, out of a total cost of Rs 9.6 crore , the government has spent only Rs. 1.1 crore . Nationalised banks have advanced loans of upto Rs 8,000 per household to individuals recommended by the project staff at very low rates of interest, repayable over 20 years. The actual expenditure per house incurred by the people has varied between Rs 10,000 and Rs 12,000. The difference between loaned amount and actual costs has been made up by people tapping their own and their relative's resources, by subsidies from the UNICEF at the rate of Rs 200 per house for private lavatories, and by subsidies from local organisations like Lions, Rotary and Jaycees at the rate or Rs 500 to Rs 1,000 to cover the costs of reinforced concrete slabs.

This process of self-help housing is well illustrated by Devnagar, a small squatter settlement until a few years ago. Today it consists of 19 little brick houses on both sides of an L-shaped area paved with stone blocks. Each house is built on a 400 sq ft plot. Some of them have mosaic floors and are plastered and painted on the outside and others have

## A Tale of Three Cities

Bangalore, Pune and Dehra Dun were for long praised as idyllic towns, cool, green and quiet. Today all three are boom towns, noisy, dusty and hot.

Bangalore is one of the 10 fastest growing cities in the world. It was a small village in the 16th century. It grew to an important textile production centre under Tipu Sultan. Under the British, the city saw some limited industrial development. Since independence, massive investment in public sector industries has completely changed its character.

Between 1971 and 1981, the city's population exploded by 76 per cent, from 1.64 million to 2.91 million. Inevitably, the total number of slums grew from 159 in 1972 to 287 in 1982; the slum population grew from 1.3 lakh to about 3 lakh, packed into 3,451 acres or 11 per cent of the city corporation area. By metropolitan standards, Bangalore can still be described almost a slumless city, but the trends are frightening.

The former Punyapur of the 8th century Rashtrakuta kings, where Shivaji once rode his horse, has not fared much better. Pune is today the base of some of the country's biggest industries, and has in the process turned into a giant sprawling along the ribbon tying it to Bombay, with a population of 1.46 million. The number of slums grew from 127 in 1950 to 327 in 1976.

As far back as 1965 a committee headed by former Planning Commission chief D.R. Gadgil had warned of a continuous urban sprawl along the Bombay-Pune road. From small villages with gram panchayats, Pimpri and Chinchwad have grown into bustling towns and the Pimpri-Chinchwad municipality into one of the richest in the country. It is now an A class municipality with an income estimated in 1978 at Rs 5 crore per annum. But investment in amenities and housing lags far behind and the area is destined to degenerate into a low amenity industrial suburb of Pune just as Faridabad is to Delhi.

Overcrowding has steadily become the bane of Pune. In 1937, 22.6 per cent of the families lived in extremely overcrowded conditions—less than 25 sq ft of area per person—in 1953, 31 per cent and in 1967, 48.6 per cent. In 1951, the hutment population was 36,725 or 7.6 per cent of the city population; in 1968, 92,100 or 11.6 per cent; in 1976, 2,73,992 or about a third of the population; today it is estimated at about 4,00,000. While the population grew at about 3 per cent a year between 1951 and 1981, the hutment population increased at about 8 per cent. Few industrial units have shown any interest in housing programmes.

Dehra Dun has suffered similar changes. The lush green hill resort used to be the preserve of government institutions like military academies, the Forest Research Institute and the Survey of India. But in the 1960s the area was declared industrially backward and concessions and incentives announced. Since then a large number of quarries and industrial units based on mined produce have come up. Of the 26 major industrial units in Dehra Dun, 50 per cent are limestone based, and 210 small scale crushers are causing serious air pollution problems. The population has grown from 30,000 to 40,000 in the early 20th century to 0.42 million and is expected to reach 0.6 million by 2000.

The problems that growth has brought in its wake are manifold. Till 1895, Bangalore City got its water from a number of tanks such as Darmambudhi, Sampangi, Ulsoor, and Sankey, supplemented by local wells and ponds. Most have been swallowed up and the disturbance in the watershed has accelerated the drying up of tanks. In 1925, the Hesarghata lake became almost dry and today the Sankey tank is one of the few that has not been swallowed up. These miniature lakes also contributed to local cooling.

The city today depends for its water on distant sources like the Arkavathy and Cauvery rivers. Because of massive water supply schemes, water inflow into Bangalore increased seven-fold between 1951 and 1983, but the per capita water availability dropped from 20 gallons per day in 1967 to 16 in 1982, and there are considerable disparities in water supply to slum and non-slum areas of the city.

A significant proportion of Pune's population has no water taps or latrines and a large proportion has to share them. More than 43 per cent of the families had to share one latrine between more than six families in 1967. But Pune is rich in water resources: the rivers Pawna, Mula and Mutha can easily meet the water needs of a city twice Pune's present size without reducing water for irrigation.

But the city has also to think of treatment of effluents to save its rivers: 75 per cent of the total water supply becomes civic sewage. "The position in Poona is shocking," says Vijay Paranjpye, a leading environmentalist. "Almost 60 million gallons of sewage has to be disposed off every day. Of this total barely 12 million to 15 million gallons are being pumped for effluent irrigation. The rest is simply dumped back into the river untreated. The result is that during the summer months, when the river flow becomes very meagre, the industrial and civic effluents make the river black, bubbly and obnoxious." The Chinchwad-Pimpri industries, including public sector units, have also been extremely slow to set up treatment facilities.

The soil erosion caused by indiscriminate quarrying and large scale deforestation in the areas around Dehra Dun has turned many perennial streams into seasonal streams and caused serious problems for the city's water supply. Less than a third of the town's population is served by the distribution network and the rest has to wait hours at public taps. Industrial development is creating additional demands for water and further stresses on water supply for households. Sewage and refuse are being indiscriminately disposed off in canals and rivers, whose channels are too small to absorb the increased flows. The Rajpur canal, once used as a source for drinking water, is today heavily polluted and the groundwater aquifer is also threatened with pollution.

Anna Mani of the Raman Research Institute has prepared a microclimate study for Bangalore. Essentially, it has changed from a rural to an urban one; with industrialisation, noise and dust pollution have increased substantially. The rapid runoff of rainfall from built areas, the absence of cooling because of denudation and reduction in greenery, and the changed reflection properties caused by use of new construction materials, have contributed to the decline. Tall buildings act as heat islands: more than 180 multi-storey complexes have come up in Bangalore in the last five years. The strong winds needed to reduce their heating effect are held at bay by urbanisation. Housing style changes are significant: a modern house in Bangalore is warmer by several degrees than a traditional house. While the rich can take resort to coolers and air conditioners, the poor must brave the heat. The pace of growth is, indeed, too hot for comfort.

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earthen floors and unplastered brick walls. It is a very neat, tidy and pleasant community with potted plants and shrubs, and a block of community latrines and a public water tap at the one end. The residents' collective pride in the transformation they have brought about is evident in the way they pull out their photograph album and show "before" and "after" pictures. In this community, the UCD project coordinated the assistance of the Rotary Club, the municipal corporation and, of course, the self-help activities of the people.

At the beginning the people themselves pulled down the huts and moved to a communal camp until their houses were built. They raised Rs 9,500 by giving concerts. The Rotary Club's contribution of about Rs 1,000 for each house was used to provide reinforced concrete pillars and concrete slabs for roofs. The people then completed this basic shell with bricks. The Rotary Club also provided ventilators, installed in the front and back walls of the house The project provided sand and cement and helped the community get building materials at reduced prices.

## Hill Horror

The British planned hill stations for their own enjoyment with the utmost care. With independence they were open to more and more people and in recent years the traffic has increased enormously. Ironically, the authorities' ambitious residential schemes and the 'development' of tourist facilities have destroyed neighbouring forests, critically reducing the towns' water supply. As a result the hill stations, a haven from the heat and bustle of the plains are dying.

Acute water shortage is common to most hill resorts. Ootacamund (Ooty) near Bangalore, situated in a district which produced 50 per cent of the state's hydel power, in 1982 faced one of the worst droughts of the century. Darjeeling, a summer time retreat for the Calcutta middle class suffers an annual shortage of drinking water. In 1983 emergency plans were made to evacuate school children and tourists were told not to visit Darjeeling. Water scarcity in the summer of 1979 forced the evacuation and closure of Matheran, the hill station closest to Bombay for several days. Mahabaleshwar, the most popular retreat for Bombay residents, is likely to meet the same fate: residential development has destroyed lakhs of trees.

In Panchgani, on Mahabaleshwar's eastern ridge, the forest department is left with a ridiculous 26 hectares of forests and Mahabaleshwar slopes are now more or less totally denuded. Due to this deforestation the Venna lake, the only water source for the town, is silting up, reducing its capacity. Schemes to desilt the lake have been rejected because the cost is said to be equivalent to that of building a new dam. In addition, the monsoon appears to be fleeing from these hills, leaving them to face a gruelling summer and scanty rain. In Mahabaleshwar, the annual average rainfall has decreased from about 400 inches to less than 250 inches.

Matters are made worse by a tremendous increase in both the permanent population and the tourist traffic. The population of Shillong in 1971 was 1.22 lakh; today it is estimated to be over 2 lakh . Nearby Darjeeling has over 53,000 people. In Simla, the summer capital of the British, civic facilites have all but collapsed. The population has increased from 6,000 in 1947 to 1,25,000 in 1983, an average of over 400 per cent. Every tourist season, one lakh people are added to the swell. The drinking water, power supply and other amenities have not even attempted to keep pace with growth.

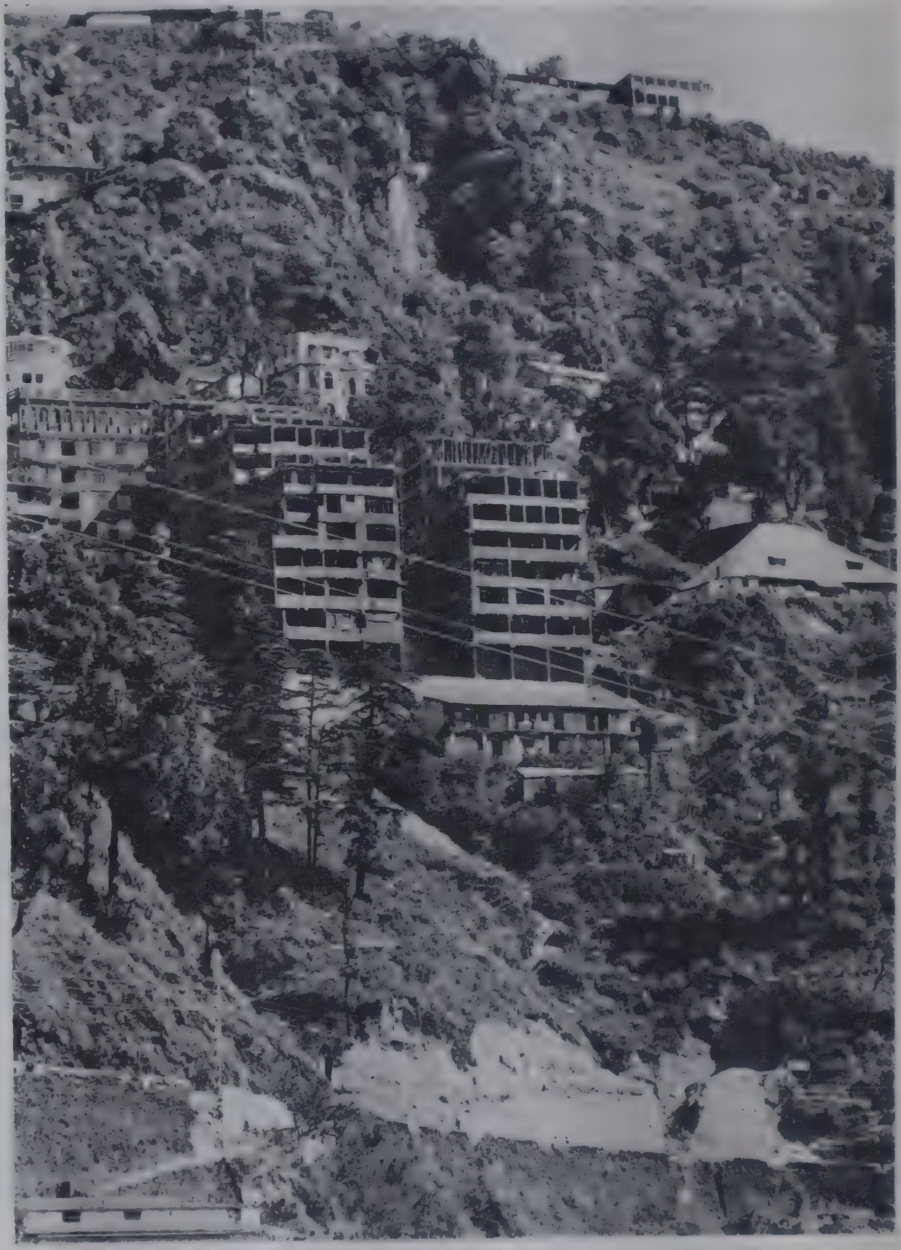
In Gangtok, in Sikkim, sanitary facilities meant for 10,000 now cater to over 40,000.

In Mahabaleshwar strict municipal laws have successfully kept the population at a steady 14,000, but the tourist traffic is threatening. Every year more than 3 lakh people visit this town, and during the peak season about 1,500 persons come daily. The natural charm of a hill resort gets battered. For instance, in Shillong, instead of towering pines, there are rows and rows of houses with brilliantly painted red and green tin roofs.

To appease the tourist invasion, there has been an upsurge of land purchases and a housing riot. Each state government is armed with plans to 'develop' the town as a tourist resort and joins the scramble to boost commercial buildings. The plans, not surprisingly, are totally incongruous: luxury hotels, video clubs, health clubs and shopping arcades. The politically powerful lobby of real-estate agents and building contractors gets its own way and has circumvented all existing regulations. Mussoorie and Mahabaleshwar have been particularly damaged by their illegal structures.

In late 1983; Mussoorie was shaken by land scandals directly implicating top officials. Eight multi-storeyed structures were said to be sanctioned in violation of municipal bye-laws. Official orders denying building permission had vanished from the files. Plans were hurriedly passed, hundreds of trees felled, and construction started. But a public uproar at the local and national level forced the government to reverse their decision.

In Mahabaleshwar builders have bought agricultural land along the Mahabaleshwar highway and obtained permission to build on it by converting it to non-agricultural use. In the last three years 1,545 plots have been allocated for development purposes. If plans materialise, Mahabaleshwar will be double its present size in the next few years. In a government report on Mahabaleshwar's environment, N.D. Juyal, then joint secretary to the Department of Environment warned: ''Land speculation outside the municipal limits will be at the cost of private forest and agricultural land. Unless it is checked now the entire plateau may well be destroyed within a decade and rendered unfit for habitation.''



**High rise buildings in Mussoorie in violation of municipal bye-laws. (India Today)**

However, the residents organised themselves into the Save Mahabaleshwar-Panchgani Association. They sent hundreds of postcards to Mrs Gandhi and events moved rapidly. The minister of state for environment, the governor, and the chief secretary of Maharashtra all paid them a visit. A special collector was posted exclusively for the Mahabaleshwar tehsil and a regional planning body set up. Permission to build new hotels was frozen and steps were taken to prevent illegal felling. The authorities cancelled the permission to convert neighbouring land to non-agricultural purposes. The developers are now contemplating appealing to the courts.

For the moment, thankfully, the destruction has been halted. The developments in Mahabaleshwar hold lessons for other besieged resorts—if only they would learn them.

## High Anxiety

**Rescue operation by helicopter and fire fighting in the Gopala tower inferno. (R. Chopra/Indian Express)**

On June 6, 1983, the 13-storey Gopala Towers in New Delhi went in flames. Galvanised into action, Lt-Governor Jagmohan appointed four high-power panels to report on the fire preparedness of all high-rise buildings within 48 hours.

The results were startling. Not one of the 200-odd high rise buildings, in which over half a million people work daily, observed safety regulations. 'India Today' listed the most common offences: fire-fighting equipment was not in working order; parking and storage space was being used for shops, offices and restaurants; circulation areas had been converted into offices or stores; there were no emergency exits; occupants were not trained in the use of sophisticated fire-fighting equipment; and overhead tanks meant for the wet riser system of fire-fighting had been connected to toilets and kitchens instead. Over a dozen buildings had no fire-fighting equipment at all. The Delhi Development Authority's (DDA) own headquarters, Vikas Minar, was found fire-prone and grossly negligent of safety practices.

Money-making is the main cause of all this. A square foot of commercial land in New Delhi's prestigious Connaught Place area is worth Rs 2,000 because of DDA policies which have sent land prices soaring. By converting a 10,000 sq ft basement into offices and shops, a builder will make Rs 2 crore . Many offices in such illegal spaces are virtual death traps: with every available inch put to commercial use, no room is left for safety devices.

Builders, however, blamed the civic authorities. The owner of Gopala Towers complained that the government was equally responsible by providing substandard services in high-rise buildings. "Water pressure is so low that it cannot reach the second floor. Where is the guarantee that electricity will not cause fire?" he asked.

The 'Indian Express' was reporting three months after the hullabaloo that buildings continued to remain death traps. The Delhi Fire Service had not received a single report that building owners had complied with safety suggestions. Some builders argued that only post-June 23 constructions should be asked to carry out all the new measures in the new fire code.

Even as concern died in Delhi, a nine-storey building in Bangalore—the Gangaram shopping arcade—came down like a pack of cards, killing more than 200 people. The state government was strongly criticised for the sloth with which victims were recovered from the debris, most of them poor construction workers and salesgirls. Newspapers alleged that the rescue operation was managed in a way to help the building owner—a one-time roadside book pedlar who now has powerful connections—carry away incriminating documents. Further reports alleged that a file containing the order of a former municipal commissioner to demolish the ill-fated shopping complex because of many deviations from the sanctioned plan, was not available.

Building collapses are a regular feature in Bombay. In between the collapse of the Gangaram shopping arcade in Bangalore and the Gopala Towers inferno in Delhi, Bombay's Western Railway suburban lines had to close down for days when the seven-storey Akashdeep collapsed onto the tracks, killing about 15 people.

Bombay is full of old structures which collapse at the rate of one every three days. From 1970 onwards, more than 1,300 houses have collapsed, averging 118 collapses a year. The Bombay Municipal Corporation classified 1,752 buildings as beyond economic repair, 8,707 as unlikely to last more than five years, and 19,778 as having a life of between five and 15 years. Akashdeep was, however, built as late as 1964. "Even for a city so inured to periodic collapses of dilapidated buildings, this should seem shocking, "wrote the usually staid 'Times of India'.

Dismissing the ingenious argument of Bombay's municipal commissioner that the cause of collapse was the vibrations caused by suburban trains, the paper pointed out that the real cause was corrupt officials and flagrant violations of elementary construction norms: " . . . in 1964 the owners had illicitly built an additional five storeys using insecure foundations and spurious materials. In all this, they appear to have received the backing of corrupt municipal officials. The latter, in obvious collusion with the builders and owners, levied a laughable fine of Rs 75 in 1980 and of Rs 150 in 1981. This form of collusion between civic officials and greedy builders or landlords is indistinguishable from playing with people's lives for short term pecuniary gains, even wilful man-slaughter . . . Akashdeep is unlikely to be the last collapse of its kind. It may be the beginning of a series of mishaps, all attributable to long years of short-circuiting of construction norms, bribery and adulteration of materials."

In fact, an architect, R.N. Raiked, had predicted a year earlier that Akashdeep was bound to collapse and this had been brought to the notice of the corporation but in vain. While money power rules bricks and mortar, such warnings will continue to be ignored, with catastrophic results.

Another much larger colony of approximately 250 houses vas a squatter settlement until 1981. There, too, after the ranting of pattas of 400 sq ft to each family the people ulled down their huts and moved to a temporary camp earby for a year. Unlike Devnagar, each family here btained a bank loan of Rs 8,000 which enabled it to put up he basic shell.

Even where pattas have not been granted, as in the case f V.V. Giri Nagar which stands on disputed private roperty, the improvements over the last five years are emarkable. It is still a hutment colony, but one which has lean stone pavements between rows of huts, 12 public atrines for a population of roughly 100 families, public vater taps, a working tubewell and stormwater drains which ctually work. Here, too, the families are driven by the hope f eventually getting pattas.

The slum welfare committees—members are men—liscuss activities such as sports events and study tours, upervise construction and carry complaints to project uthorities. In two slums, labour cooperatives have been organised, reducing costs by keeping out middlemen and contractors. Women's organisations look after women and hildren of lower income groups, running nurseries, overseeing the special nutrition programme and sewing classes. They also organise income generating activities.

Notwithstanding the success there remain some serious problems. The expansion of a pilot project to the city as a whole has involved a changeover from a small group of dedicated social reformers mediating between the people and the state machinery to a bureaucratic army of 400 low paid, disgruntled basti sahayaks who are now the intermediaries.

This has led to a mounting backlog of grievances. The older project directors have retired, replaced by bureaucrats whose commitment is relatively formal and low.

Another unresolved problem is that of granting pattas to slums on private land. When the municipal corporation notifies an area as a slum and begins acquisition proceedings, the landlords take the matter to the courts and the dispute goes on for years. Over 50 per cent of the city's slums are located on public land and their acquisition has posed fewer problems. Moreover, the majority are small settlements with an average size of about 50 to 75 households: the size of land to be acquired tends to be small and relatively more dispensable by the departments concerned.

But when the plot of land is large, as with the city's largest slum, a sprawling colony of roughly 800 huts located on land meant for housing defence personnel then the only solution is mass relocation of the slum population outside the city because there is no vacant plot of this size within the city, or to relocate the powerful defence personnel. The net result is that this slum remains outside the purview of the programme. In cities like Bombay and Calcutta where average slum size is much larger the resulting property disputes are likely to be more complex.

Finally, the bank loans: defaulting on payment after the first few instalments is widespread. The present practice of asking the basti sahayaks to act as instalment collectors serves only to further strain relations between them and the people.

## Cities as a collection of shacks

Many major cities have moved from slum demolition and mass eviction to slum assistance. Self-help is an important ingredient, making government intervention in the housing sector more effective. But projects have fallen short of expectations: production of serviced sites is low and they are not accessible to the very poor; slum upgrading has been superficial, of no lasting significance.

Land is of central importance. Governments have gone in for vacant, peripheral plots, avoiding the issue of finding lands by means which can be replicated on a large scale. In slum upgrading projects, the land issue, except in Hyderabad, has been avoided altogether. This has had serious consequences: the upgraded houses join the housing market uncontrolled by the authorities, and the poor can be squeezed out if they can't afford to pay the higher rents, or can be tempted into selling.

If the urban poor are to have significantly improved access to upgraded slums and new, serviced sites, the government must flood the city's low-income housing market with self-help housing stock. Otherwise even the few sections of the urban poor who have benefited from protected pilot projects will soon be displaced by market forces. That this danger can be avoided and real progress made in self-help housing for the urban poor is demonstrated by the case of Hyderabad's upgrading programme which recognised the importance of granting land tenure from the very beginning.

At present, government policy wavers between slum improvement and slum bulldozing. There is no clear national plan to give every city dweller a proper roof. A fundamental choice has to be made. As M.N. Buch argues, either Indians can plan for "a built environment in which every citizen has reasonable access to water, lives in developed lots where drainage is satisfactory and where roads are so designed as to provide efficient and cheap public transport" or for "one in which there are areas of excellence and other areas of total degradation". If it is accepted that the former choice alone will lead to a better quality of life for the maximum number of people, then Indians will have to reconcile themselves to the fact "that for years to come our cities will be just a collection of shacks".

This means that the perceptions of planners and architects will have to change dramatically. The power of the upper classes, who want to use the cheap labour of slum dwellers but want to deny them a home, will have to be curbed. Ultimately, urban land must become a national asset used in the interests of the majority, not of a small minority.

# PEOPLE

*India can feed 2.5 times the projected population at the turn of the century. But more than family planning, the answer lies in proper soil and water management.*

*The Green Revolution notwithstanding, Indian agriculture is witnessing diminishing returns. Inputs increased at an annual 4.2 per cent during the '70s but output by only half that rate.*

*The destruction of forests and reduced access to biomass like bamboo, grasses and wood play havoc with millions of craftspeople. While the Uttar Pradesh government provides cheap bhabhar grass to paper mills, 40,000 baan-making families face starvation.*

*The most affected by biomass destruction are women. Many households spend up to 10 hours daily fetching fuel, fodder and water. Even pregnant women work 14 to 16 hours a day.*

*An average family in an average Karnataka village walks 1,400 km a year fetching fuelwood, equivalent to walking from Delhi to Bombay every year. In deforested hills and deserts, the treks are longer and more difficult.*

*Landless women suffer all the way: they own few of those resources which yield cooking fuel (trees, cattle or croplands), they spend hours collecting fuel, which is then burned in fuelinefficient stoves that turn kitchens into gas chambers.*

*Efficient stoves and easy access to fuel and water could save a fifth of the energy spent daily by women in an average village. In villages worse off, the saving could be much more.*

*At least 2 million to 3 million jobless and landless people, mainly women, eke out a bare living selling firewood smuggled from forests. Headloading is today an occupation of last resort for many tribals.*

Is India an overpopulated country, its large and growing population a major cause of environmental destruction? It has been repeatedly argued that the population pressure has outstripped the country's capacity to cope. But while there is a plethora of loose statements, there is no rigorous scientific study on the production potential of the country's lands. The UN study reported in this chapter—the most rigorous undertaken as yet—shows that India can feed three to four times its current population, but this will be possible only if the Indian government and people can learn to manage their soil and water resources properly. If there is poverty and hunger in the country today, or even apparent overpopulation, it is only because the country's scientists, politicians and planners have not learnt how to use the country's environment at a high level of sustainable productivity.

In fact, the earlier production systems and social organisation of tribals, nomads and various other traditional occupations and cultures, which were based on sound ecological principles are being rapidly destroyed in the name of economic development and modernisation. The environmental destruction that has followed is making the lives of Indian people humanly impossible, particularly of women who have to fetch daily household needs from the immediate environment. To survive, the poor often have no alternative but to turn upon the very environment with which they lived in full harmony in the immediate past. Millions of people today see no alternative for survival other than selling firewood from forests—a new profession that has emerged with amazing rapidity. A people biased development process—especially a women-biased process—would not only demand the restoration and enhancement of nature but would also bring about family planning and stabilise population.

# POPULATION AND ENVIRONMENT

Consider the bare figures. Between 1901 and 1951, India's population grew from 238 million to 361 million, an increase of about 52 per cent over 50 years. Between 1951 and 1981, it expanded from 361 million to 685 million, a whopping increase of 90 per cent in just 30 years. India literally added a second India in the 35-odd years of its independence.

In 1967, William and Paul Paddock wrote a book called "Famine 1975—America's Decision: Who Will Survive?" They classified developing countries, based on their population growth rates and food production potential, into three categories: 'can't be saved', 'walking wounded' and 'should receive food'. India suffered the ignominy of being classified as 'can't be saved' with the comment that it "is the bellwether that shows the path which the others, like sheep going to slaughter, are following". India was a country, according to the authors, to which the US should not have bothered either to provide aid or food.

Fortunately, India's food production managed to keep ahead of population growth, which helped it through some of the most critical drought years like 1979. But the apparent stagnation in agricultural production—though in 1983-84 a new record foodgrain production of over 150 million tonnes was recorded—once again created despondency.

The 1981 census results turned out to be even more of a shocker than usual. The Planning Commission had just put the finishing touches to its Sixth Five Year Plan when the registrar general of census announced that the country had some 13 million more people than the number estimated by the planners and that the birth rate was not 33 per 1,000 people but around 36. The Planning Commission had to hastily restructure the sixth plan to bring it into line with the new figures.

The key question for expert and layperson is: can India's lands support such a large and growing population? This is where the 'carrying capacity' comes in. It is the number of people or animals that an area of land can support on a sustainable basis. Unfortunately, not one expert in the country has attempted to quantify the carrying capacity of the area under a single development block, leave alone the whole country.

Indeed, it is an extremely complicated and uncertain business trying to set a figure to the number of beings a piece of land can support. Take the case of Fiji where, in 1973, UNESCO and the United Nations Fund for Population Activities (UNFPA) launched a pilot project to study the population-environment relationships in the eastern islands. The number of ecological variables were found to be enormous, putting paid to all efforts to put a figure on the small islands' carrying capacity. Only specific inferences were possible. For instance, eastern Fiji is caught in the stranglehold of the declining copra industry and is suffering from poverty and emigration. If the colluvial soils which have been planted with increasingly unproductive coconuts for copra export were converted to farming of taro, a root crop, it was estimated that up to five times more people could be supported with this economy than if they continued with copra. Any talk of carrying capacity must clearly be marked with great caution.

In a modern interdependent world, where trade plays a major role, the population supporting capacity of a particular area can in fact be increased enormously by importing a few critical items like plant nutrients from outside. Densely populated Europe today is heavily supported by the production of a range of items outside European countries, especially in the developing countries. The UN has never dared to estimate how much land in the developing world is today producing food and other items like timber for the developed world and how the quantity of this land has been changing over time. If such a study were undertaken, it would clearly show that, despite decolonisation in large parts of the Third World over the last three decades, many times more land is being used in developing countries to meet the needs of the developed countries as compared to 1950, and today this land use is a major cause of environmental destruction across the Third World. For instance, the first major attack on India's natural forests came with the demand to establish tea plantations to satisfy colonial Britain.

**Indian food situation over the 70's**

| | Average 1969-71 | Average 1978-80 |
|---|---|---|
| Population (million) | 552.5 (1970) | 684.5 (1980) |
| Population Index | 100 (1970) | 124 (1980) |
| Food Production Index | 100 | 127 (1979-81) |
| Food Production per capita Index | 100 | 102 (1979-81) |
| Calories per capita per day | 1999 | 1998 |
| Protein per capita per day (gm) | 49.5 | 48.5 |
| Fat per capita per day (gm) | 29.2 | 29.5 |

Note :- (1) It is important to note that the quantities of food available indicated in the table relate to the quantities of food reaching the consumer but not necessarily to the amounts of food actually consumed, which may be lower than the quantity shown depending on the extent of losses of edible food and nutrients in the household.

(2) The figures represent only the average supply for the population as a whole and do not indicate differences amongst socio-economic groups and ecological zones and seasonal variations.

Source: 1981 FAO Production Yearbook Vol. 35, Rome, 1982, FAO.

## Indian prospects

But what of India? It is useful to ask just what our land is physically capable of producing on a sustainable basis, without going into the thickets of social organisation and land reform. In late 1983, the Food and Agriculture Organisation (FAO) released an extensive study on the subject, 'Potential Population Supporting Capacities of Lands in the Developing World', the result of almost a decade's work that began with the preparation of a world soil map.

The picture of India that emerges is both exhilarating and sobering. Simply put, India has enormous problems but also has an equally enormous natural resource base to solve them with. Assuming a low level of inputs: local low-yielding varieties, no fertiliser use or chemical pest, disease and weed control, long fallow periods, no long-term soil conservation measures, high rates of soil erosion, steadily declining soil productivity, manual labour with hand tools as the only power source, high labour intensity, subsistence production and fragmented landholdings, the

**Potential population supporting capacity of India's lands**

| | Year 1975 | Year 2000 |
|---|---|---|
| Actual population (million) | 618.7 | 1036.6 |
| **Low inputs** | | |
| Potential supportable population (million) | 499.7 | 1298.1 |
| Contribution of irrigated lands (%) | 56 | 87 |
| **Intermediate inputs** | | |
| Potential supportable population (million) | 1130.2 | 1800.1 |
| Contribution of irrigated lands (%) | 25 | 63 |
| **High inputs** | | |
| Potential supportable population (million) | 2191.0 | 2619.9 |
| Contribution of irrigated lands (%) | 13 | 43 |

Source: Potential population supporting capacities of lands in the developing world, FAO/IIASA/UNFPA, Rome 1982

study reports that the population supporting capacity of the irrigated and rainfed areas together was 1.56 persons per hectare in 1975 compared to the 1.93 that existed in reality In other words, in 1975, India had 119 million—or 19 per cent of the population—more people than its lands could support.

But assuming high and intermediate levels of inputs, the potential population supporting capacity of India's lands shot up to 6.84 and 3.53 persons per hectare: India's lands could have fed as much as three and a half times the existing population in 1975.

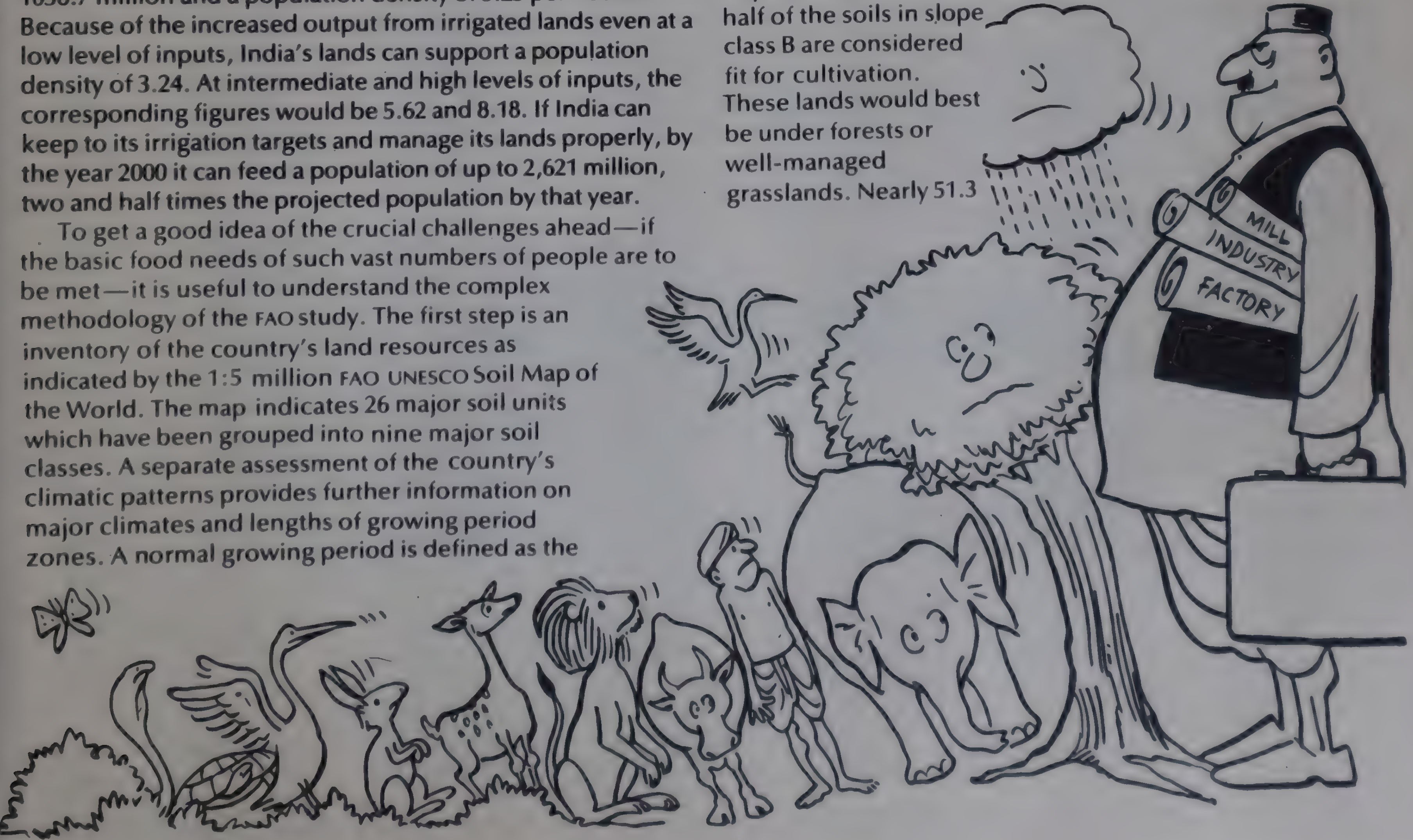
By the year 2000 the picture changes for the better because of the country's massive irrigation development plans. That year, India is expected to have a population of 1036.7 million and a population density of 3.23 per hectare. Because of the increased output from irrigated lands even at a low level of inputs, India's lands can support a population density of 3.24. At intermediate and high levels of inputs, the corresponding figures would be 5.62 and 8.18. If India can keep to its irrigation targets and manage its lands properly, by the year 2000 it can feed a population of up to 2,621 million, two and half times the projected population by that year.

To get a good idea of the crucial challenges ahead—if the basic food needs of such vast numbers of people are to be met—it is useful to understand the complex methodology of the FAO study. The first step is an inventory of the country's land resources as indicated by the 1:5 million FAO UNESCO Soil Map of the World. The map indicates 26 major soil units which have been grouped into nine major soil classes. A separate assessment of the country's climatic patterns provides further information on major climates and lengths of growing period zones. A normal growing period is defined as the period in which rainfall exceeds evaporation and a growing period of less than 75 days is considered to be inadequate for crops. Data on the climate also provides information on whether the temperature poses any serious constraint on crop growth.

By integrating data from the land and climate inventories, it is possible to get a quantification of the land resources of a country in terms of soil and climatic conditions which can then be matched to the soil and climatic requirements of crops. In other words, this exercise results in hundreds of agro-ecological cells, each quantifying the extent of each individual soil (further broken down by soil phase, slope and texture class) as it occurs in each major climate and in each length of growing period zone.

In the case of India, for instance, nearly 85 per cent of the land (270.5 million hectares) has a climate suitable for agriculture, where both rainfall and temperature conditions are adequate for crop growth. But only 57 per cent of this land (155 million hectares) has soils with no inherent fertility limitations. Of this land, too, about 60 per cent (95.6 million hectares) has a very short growing period of 75-179 days. On this land irrigation can lead to greatly enhanced production as water availability is the only constraint on production.

But slopes will also pose limitations. India's soils have been divided into three slope classes: slope A, level to gently undulating, where dominant slopes range between 0 to 8 per cent; slope B, rolling to hilly, where dominant slopes range between 8 and 30 per cent; and slope C, steeply dissected to mountainous, where dominant slopes are greater than 30 per cent. No soil unit in slope class C and only half of the soils in slope class B are considered fit for cultivation. These lands would best be under forests or well-managed grasslands. Nearly 51.3



per cent of India's land is in slope class A, 35.5 per cent under slope class B, and 13.2 per cent under slope class C. A large part of India's soils with no inherent fertility limitations are under slope classes B and C (together 87.9 million hectare)

Irrigation plays a very important role in boosting food production in India—more so than in most other developing countries. In its study 'Agriculture: Towards 2000, FAO points out that nearly three-fourths of the Third World's additional irrigation capacity will arise in the Far East between 1980 and 2000, and about three-fourths of this will arise in India alone.

In 1975, when India's land could feed only 500 million people using low inputs as against an actual population of 619 million, irrigated lands were meeting the needs of 280 million, that is, 56 per cent of the potential population that could be supported. By the year 2000, the study estimates that irrigated lands will be supporting 87 per cent of the potential supportable population of 1298 million in that year. In other words, irrigation plays and will have to continue to play an extremely important role in the years to come if India's population is to be fed. And this irrigation will have to take place in a manner that is sustainable and not destructive of land through waterlogging and salinity.

To get an estimate of the land that would be under rainfed production, FAO experts subtracted the land under irrigation and land under non-agricultural uses. To get an estimate of the land under non-agricultural use, the study takes an average figure of 0.05 hectare per person of non-agricultural land. This means that in 1975 India needed 31 million hectares of non-agricultural land (10 per cent of the total land area) and by 2000 it will need 52 million hectares (16 per cent of the total land area).

### Productivity exercise

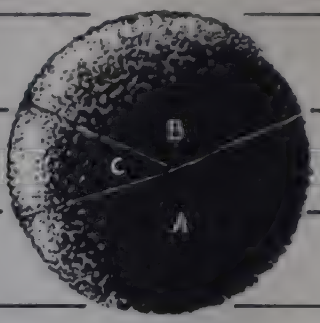
In this way, the study obtains a number of agro-ecological cells available for rainfed cultivation. After selecting the input level (low, intermediate or high), each agro-ecological unit is then analysed separately for 18 different crops, including grasslands, to get an estimate of the livestock potential. Thus, the study obtains the crop which is most productive under the unique circumstances of the soil and climatic conditions of each agro-ecological unit. This gives the total productivity of each agro-ecological unit.

**Area covered by dominant climates in India according to suitability for agriculture**

| Type of climate | Area covered (million hectares) | % of total land |
|---|---|---|
| A. Cold (severe temperature constraints) | 17.97 | 5.62 |
| B. Warm/Cool (no severe temperature constraints) of which: | 301.64 | 94.38 |
| Dry all year round (0 days) | 6.46 | 2.02 |
| Inadequate growing periods (1-74 days) | 24.67 | 7.72 |
| Short growing periods (75-179 days) | 172.77 | 54.06 |
| Long growing periods (180-365 days) | 97.73 | 30.58 |
| | 319.61 | 100.00 |

Source: FAO

**Extent of Indian soils by slopes**



| % of total area | Area (million hectare) |
|---|---|
| 35.48 | 113.23 |
| 13.22 | 42.18 |
| 51.3 | 163.70 |

Notes: Slope A– level to gently undulating; dominant slopes ranging between 0 and 8 per cent.
Slope B– rolling to hilly; dominant slopes ranging between 8 and 30 per cent.
Slope C– steeply dissected to mountainous; dominant slopes are greater than 30 per cent.
Source: FAO

But a number of restraints are also applied to ensure productivity on a sustainable basis. Limitations on production are imposed by phase, slope and texture of the soils in each agro-ecological unit. Fallow requirements pose yet another constraint. The earth must rest, lie fallow between periods of cultivation—so that it can regain its normal vigour. The extent of the necessary rest period depends on the level of inputs, soil and climatic conditions. and crops.

With low levels of inputs in the humid tropics, cultivation of Arenosol soils (2.4 per cent of India's lands) is only possible one year out of 10 if productivity is to be maintained and land degradation avoided. In contrast, Gleysol soils (2.6 per cent of India's lands) may be cultivated six years out of ten with the same level of inputs and climatic circumstances.

Probably the most important factor in agriculture is land degradation. Land degradation resulting from soil erosion soil loss by water and wind, salinisation and alkalinisation, waterlogging, depletion of plant nutrients/organic matter, deterioration of soils structure and pollution, can lead to partial or even total loss of productivity, argues the FAO study. It is, therefore, very important to take this into account for calculating future productivity and population supporting capacity. Whereas it is possible to estimate the rates of soil loss under specific climatic, soil and land use circumstances, there is still no definite method to calculate the impact of soil loss on productivity. The FAO has used certain interim relationships between rates of soil loss and loss of productivity until further studies can show more accurate relationships.

An extremely important aspect of the FAO study is the fact that it considers soil conservation an important aspect of agricultural management. The scenarios dealing with low levels of inputs assume that no soil conservation measures are being undertaken and hence a full rate of soil loss and loss in productivity takes place. Intermediate levels mean

## The Grain Gap

Contrary to all predictions, India's foodgrain production in 1983-84 was a record 150 million tonnes. The previous highest was 133.3 million tonnes in 1981-82. Wheat is expected to be 43 million tonnes and rice a record 57 million. The Ministry of Agriculture's annual report claims that 1983-84 is going to be a watershed, indicating impressive recovery as well as upthrust. But only time will tell if 1983-84 indicates a new growth surge or is just a flash in the grain bowl.

Increase in agricultural production is usually the result of two major factors: increase in area under cultivation and increase in productivity in terms of yield per hectare. The annual rate of increase in cultivated area dropped considerably in the 1970s as compared to the 1950s. This is not surprising: half of the country's geographical area is already under the plough. The scope for extending the area under cultivation continues to shrink with each year.

Productivity shows no major acceleration either. In fact, the growth rate (compound) of agricultural production in the last two decades works out to around 2.4 per cent per annum which is less than the 3.3 per cent registered in the decade 1950-51 to 1960-61. In the decade ending 1970-71 it dropped to 2.3 per cent and further to 2.2 per cent in the decade ending 1980-81. Thus the current growth rate is just about equal to the population growth rate, which implies a near-stagnation in per capita agricultural production.

In a study conducted by the late Narottam Shah of the Centre for Monitoring Indian Economy, (CMIE) the frank question was asked: "Then what about the Green Revolution?"

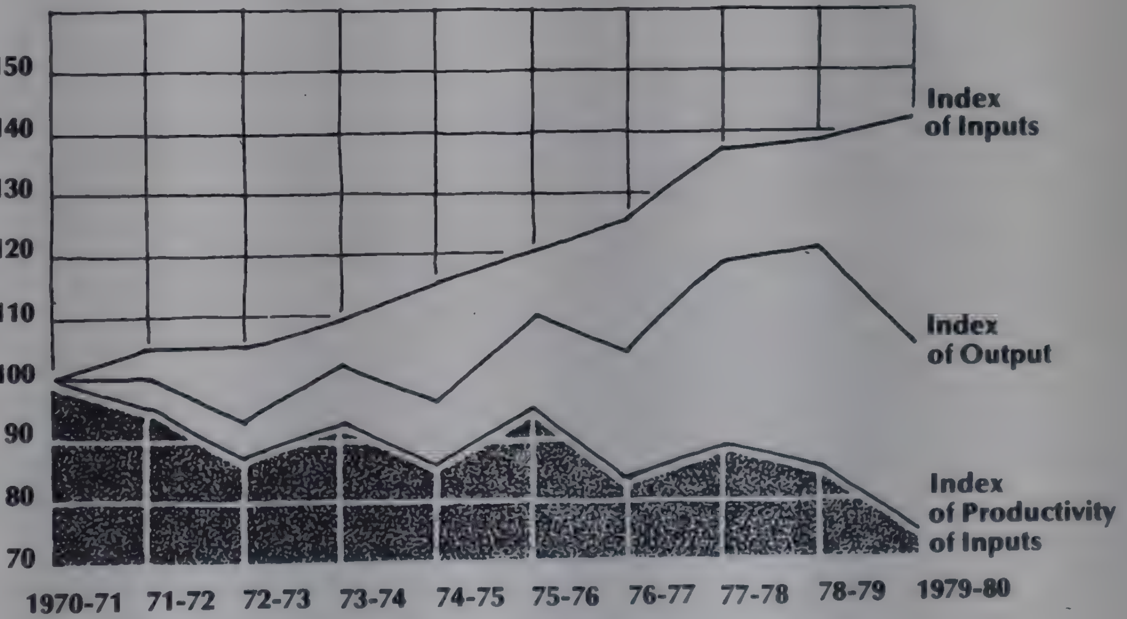
Firstly, the Green Revolution was little more than a wheat revolution. The sharp improvement in wheat production was offset by poorer improvement in other crops so that the overall rate of increase ceased to be very dramatic. Even in wheat production, there is clear evidence of some slackening. Almost the entire increase in wheat production came from the shift from the traditional varieties to high-yielding varieties in the wheat growing areas. By now, around 80 per cent of the wheat area has been brought under high-yielding varieties. Obviously, with time, the scope for a further shift becomes limited. The rate of increase in wheat production has dropped from around 10 per cent per annum in the early years of the wheat revolution to around 5 per cent during recent years.

But this stagnation in productivity is surprising because, as the CMIE study shows, there has been a literal revolution in agricultural inputs. Between 1976-77 and 1982-83, gross irrigated area increased at the rate of 5.6 per cent per annum, the number of diesel and irrigation pumpsets increased at the rate of 8 per cent to 9 per cent, consumption of power for agriculture increased at the rate of over 12 per cent per annum, area under high-yielding varieties increased at the rate of around 7 per cent per annum, and fertiliser consumption increased at the rate of 11 per cent per annum. Why has then there not been a corresponding revolution in output?

Shah calculated that while all the inputs in real terms put together had increased at the rate of 4.2 per cent per annum between 1970-71 and 1979-80, the real output increased at only about half that rate: 2.3 per cent per annum. As a result, the index of productivity of inputs declined sharply from 100 in 1970-71 to 75 by 1979-80. Shah concluded: "It is abundantly clear that what we are witnessing is the familiar phenomenon of diminishing returns to inputs in agriculture."

Why should be so? Firstly, Shah argued that India's heavy reliance on irrigation, high-yielding varieties and fertilisers no longer appears to be delivering the goods. This strategy is also creating inequities. Around two-thirds of India's farmers are engaged in dry farming and only around one-third in irrigated farming. Against that more than two-thirds of India's agricultural development expenditure is devoted to irrigation and irrigation-based farming and less than one-third to dry farming. Dry farming demands measures for water harvesting and soil and water conservation. The neglect of dry farming has led to gross imbalances in the country's development. But even the yields of India's irrigated lands are dismal and nowhere near yields recorded by many other countries.

Probably the biggest gap in India's agricultural technology is that it has never been developed taking into account the ecological base of the country's agriculture. A comprehensive package of agricultural practices based on a clear understanding of ecological possibilities and constraints needs to be worked out, suitable for each watershed and soil-climatic regime of the country. A number of ICAR (Indian Council of Agricultural Research) research stations have developed useful ideas and techniques but all in a disparate manner. There is no integrated package. As Shah concluded: "What is required is a thorough education of every farmer in half a million villages across the country. What should be given is not a couple of tips in respect to a couple of crops but a fairly wide-ranging education in the basic elements of ecology and agriculture. What we need for this is literally hundreds of thousands of regular training classes for the farmers during the season. Without such extensive and thorough agricultural training of the farmers, there is no future for Indian agriculture nor for the Indian nation."



Source: National Accounts Statistics, 1970-71 to 1979-80,

India has 143 million hectares of arable land. Of this, about 70 million hectares will be irrigated by the year 2000. Professor S.K. Sinha of the Indian Agricultural Research Institute points out that average yields of 41 tonnes per hectare from irrigated lands and 2 tonnes from non-irrigated lands—extremely low yields by world standards—should give India a total production of 426 million tonnes of grains. Assuming that a part of this land is used for non-grain crops, India should still be able to achieve a target of 350 million tonnes of grain. The US study Global 2000 projected a total requirement of only 299.57 million tonnes for all of South Asia by the end of the century. The potential for comfortable harvests exist, but the gap between potential and performance is vast and, for the moment at least, seems unbridgeable.

some conservation measures and 50 per cent rate of soil loss, and high level of inputs means complete conservation measures and acceptable rates of soil loss with no impact on land productivity.

The FAO study does not publish separately any data for rates of soil loss in India but the study does show that the Southeast Asia region (which includes India) is the most susceptible region in the world to soil loss. Given the fact that India has large arid and semi-arid lands and also large tracts of land under higher slopes it would be correct to surmise that soil loss is a serious problem for India. If soil erosion were to continue unchecked, rainfed croplands in Southeast Asia would decrease by 35.6 per cent by 2000 and rainfed crop productivity by 38.6 per cent.

The study also takes into account land that would have to be allocated for seed production and assumes 10 per cent harvest and post-harvest losses. The final variable is the choice of crop. At the low level of inputs, the study assumes that presently grown mixture of crops will be cultivated, regardless of the total calorie-protein production. At the intermediate level of inputs, the mixture of crops grown changes partly towards the crop giving the highest calorie production in each agro-ecological unit, and at the high level of input, only the optimum mixture of crops is grown. At the high and intermediate levels of inputs, a minimum protein requirement is also built into the optimal cropping mixture. In this way, the maximum possible production is estimated and matched with the requirements of the country's population.

### Study limitations

There is no doubt that the study has many shortcomings and despite its complicated nature can only be called a first approximation of the carrying capacity of India's lands. Firstly, the scale of the soil map ought to be enhanced in any detailed study of India, which will provide better data on the extent of India's agro-ecological units. Secondly, the study does not earmark any land for production of cash crops. All areas under higher slopes have been kept aside as fit for forests for reasons of soil and water conservation, but no estimates have been made for lands that would be needed to produce firewood and timber near villages. Thirdly, the study does not take into account the possibilities of producing fish and products like algae from freshwater bodies and along the coast. Fourthly, the study assumes that irrigated lands will produce as expected which, given the past production record of irrigated lands, is highly optimistic especially in the case of India; a separate assessment is needed on sustainable

### The Kerala Factor

In 1978, the Sample Registration Scheme showed that Kerala had the lowest birth rate of all Indian states: 25 per thousand as against 33 for India. What is particularly intriguing is that up to 1941-50, Kerala's birth rate was higher than the all-India average. No wonder that family planning mandarins, constantly plagued by unachieved targets, have been consistently trying to probe Kerala's achievement.

Many socioeconomic factors have been cited as responsible for the rapid decline in birth rates. Among them are the rising age at marriage of women, increasing use of contraceptives, high female literacy rate, rapid decline of mortality, equal distribution of income and social services, and high wage rates for agricultural workers.

Demographer Moni Nag has compared fertility rates in West Bengal and Kerala. Both states are densely populated, share a historical emphasis on education and have had long periods of rule by left-oriented parties. Nag's study shows that Kerala is 'poorer' than West Bengal, one of the poorest states of India. In fact, its per capita income, both urban and rural, is less than West Bengal's. It is also less industrialised and has greater inequalities in income. Yet Kerala's birth rate has been lower than West Bengal's from 1951-60, belying traditional thinking that greater industrialisation and incomes lead to lower birth rates.

Among the main reasons given by Nag for the low birth rate is the high average age of women at marriage—21 years in 1971 in Kerala as against 17 for India—and the greater success of family planning programmes during the 1970s: 29 per cent of couples covered against the all-India average of 23 per cent.

Kerala's education and health programmes have also played an extremely important role. Kerala is unique in having 53 per cent of its rural women literate as against the all-India average of 13 per cent. The state has emphasised primary education unlike, for instance, West Bengal: in 1969 Kerala spent 59 per cent of its education expenditure on primary education compared to West Bengal's 38 per cent. In 1978, 86 per cent of children of the 6-10 age group in Kerala were enrolled in school compared to 68 per cent in West Bengal and, even more revealing, 86 per cent of girls as against 82 per cent boys. The corresponding figures for West Bengal are 58 per cent and 77 per cent respectively. In the same year, 74 per cent of girls in the age group 11-13 years in Kerala were enrolled in schools, while only 32 per cent were enrolled in West Bengal. However, at college and other higher levels of education the proportion of women is as small as in other states.

Health facilities in rural Kerala, which means 84 per cent of the population, are better than in most Indian states including West Bengal. In 1974, all primary health centres (PHCs) in Kerala had their minimum quota of two doctors each. In the same year only 30 per cent of PHCs in West Bengal satisfied this minimium, even though many of them were situated in small towns rather than villages. The extent of health services in rural areas depends quite heavily on the number of sub-centres attached to the PHCs. In 1970, Kerala had 11 sub-centres per PHC whereas West Bengal had only 6.2. The better health facilities are reflected in low death rates in Kerala, namely 18, 16, and 11 in the decades 1941-50, 1951-60 and 1961-70 respectively, as against West Bengal's 29, 21, and 19 and an all-India average of 27, 23 and 18. Kerala has the lowest death rate in India.

Public distribution of food is another important factor. Kerala's rationing system covers 97 per cent of its population, which buys grain at a price one-third to one-half of that on the open market. The food is distributed through a network of licensed retail shops. Unlike other states, where the ration shops are concentrated in towns and cities, Kerala's ration shop system extends throughout the state. The food distributed through these channels represents 15 per cent to 16 per cent of Kerala's total calorie intake and about 19 per cent to 20 per cent of its protein intake.

Nag mentions that rural per capita consumption data on the poorest groups in Kerala showed that their consumption levels have improved to a greater extent than in West Bengal since 1967-68. Perhaps there is a link between this improvement and the expansion of Kerala's public food distribution system, which dates from 1964. To some extent, the change in ownership of land due to land reforms might also have contributed to improvement in consumption levels though there are varying opinions on whether land reforms have really been effective in alleviating poverty.

The lesson is obvious. Kerala makes a strong case for extensive primary education, especially that of women, the spread of health facilities and better distribution of cheap food. When women are educated, demand for contraception follows. Family planning, by itself, is clearly not enough.

productivity from irrigated lands. Fifthly, the higher inputs scenario assumes much larger use of fertilisers and pesticides and this could lead to serious environmental consequences. It would be better to assume a high input scenario based on biological nitrogen fixation, use of organic resources and integrated pest management techniques.

On the other hand, this rigorous exercise does show that in principle India should have no difficulty in meeting the food needs of its population for at least a century. The challenge lies in removing the socioeconomic constraints to agriculture and moving towards higher levels of environmentally acceptable inputs. Indeed, in all areas where agricultural inputs have increased, agricultural production has increased and kept ahead of population growth. But because of environmental neglect a word of caution is necessary: whether even the high-input areas will provide sustained yields remains an open question.

The FAO study shows that a significant part of the increased production must come from its irrigated lands. Unfortunately, not only are yields from India's irrigated lands dismally low, nearly a quarter to half are threatened with waterlogging and salinity. In most areas, organic manuring is neglected. In the high production areas of Punjab, the problem of micronutrients is growing rapidly and soil fertility is being rapidly depleted. The drylands of India have been completely neglected and few measures for water harvesting and soil and water conservation have been promoted. R.J. Dudal, director of FAO's soil and water division points out that probably the most important input immediately needed is soil conservation measures: the land resources base cannot be taken for granted.

Madhav Ashish environmentalist, has argued that good management of crop lands will require an equally good management of forest and grazing lands. For instance, the destruction of forests means shortage of firewood and greater use of cowdung as fuel which affects the fertility of the crop lands. The indiscriminate expansion of crop lands into marginal areas earlier used for grazing, means that not only grazing lands deteriorate but that cattle are pushed into forests for grazing, preventing regeneration and creating a perpetual firewood famine.

In sum, what the FAO study shows clearly is that the key factors that will determine future success are good soil and water management measures. Unfortunately, both elements are completely lacking in our agricultural management system. If India's people were to go hungry, it can be said with authority that it would not have anything to do with their number but with the callous mismanagement of the country's natural resources. Probably more than family planning programmes, India needs national 'ecodevelopment' programmes.

Ultimately, it is the nature of Indian society that will determine the carrying capacity of India's lands. Clearly, in a society where cooperation plays a major role in the use of natural resources as opposed to competition and personal acquisition, the carrying capacity will be much larger than what it is today.

# CASTE AND ENVIRONMENT

The question has troubled sociologists for years. How has India's caste system, so elaborate — an estimated 40,000 castes — rigid, hereditarily determined, hierarchical and oppressive a social structure lasted for so many centuries? Madhav Gadgil, an ecologist and anthropologist Kailash Malhotra feel that the answer probably lies in the discipline that the caste system brought to the use of natural resources. It was a system which, on the one hand, forced its members to share natural resources and on the other, created the right social milieu in which sustainable patterns of resource use were encouraged to emerge. In other words, it was a social system which both forced and cajoled the social being right from birth to adopt sustainable cultural mores.

Within the caste system, birth determined a human beings's occupation. An "ecological space" and its natural resources could only be used by a definite occupational group. This "resource partitioning" helped to reduce competition and, hence, conflict among human beings over scarce natural resources, and to create the right psychological environment: the allottees of an ecological space developed sustainable patterns because they had no worry that their resources would be snatched away from them and probably also because they knew that if they exhausted the resources in their own space, thev would not be allowed to use any other.

Malhotra and Gadgil are quick to point out that even though the caste system lasts till today, it has stopped "resource partitioning". The growing monetarisation of the Indian economy, first encouraged by the invading British then by indpendent India in the name of development, has destroyed the ancient sustainable and shared patterns of resource-use evolved over centuries. Social tensions are increasing as people fight over scarce natural resources, and because the caste system continues even after losing its raison d'etre, it has become a source of social power and oppression.

These conclusions emerge from a 12-year study of rural society in western Maharastra. Here the Western Ghats rise abruptly, some 50 km inland from the Arabian Sea, to an altitude of 1,000 metres to 1,500 metres. Their 15 km to 20 km wide crestline is marked with heavy rainfall, more than 3,000 mm a year and it supports low but stable agricultural and pastoral productivity. The simple society here, mostly marked by single clan settlements, consists of a few sedentary castes of cultivators, pastorlists and hunter-gatherers, which include Gavlis who are mainly cultivators, and Kunbis who are buffalo herders and shifting cultivators.

Further eastward, the Western Ghats merge with the Deccan Plateau through a series of broken hills, and the rainfall in this tract falls to about 1,500 mm to 1,000 mm near the edge of the plateau. This tract supports rich agriculture and harbours a complex rural society with a number of artisans and service castes. Still further east, the rainfall decreases further, to less than 600 mm in a semi-arid tract of 100 km to 150 km width. Agriculture here is practised only in the river valleys. Pastoralists and hunter-gatherers use large tracts of uncultivated land.

Because the terrain favours sedentary existence during the four monsoon months, and uncultivated lands are available for grazing, several pastoral as well as non-pastoral nomadic castes have established their base villages in this semi-arid tract. They migrate to the higher rainfall tracts, both to the east and west of the semi-arid tract, for the eight dry months of the year. Among those who have their base villages in this tract are Hatkars, Tirumal Nandiwallas, Fulmali Nandiwallas, Vaidus and Phasepardhis.

**Niche diversification**

The first example of "ecological niche diversification" is exhibited by the Kunbis and Gavli Dhangars living on the crestline of the Western Ghats. The Kunbis cultivate paddy in the river valleys, practise shifting cultivation on the lower hill slopes and hunt extensively. They barter their cereals for butter produced by the Gavlis and other goods. The only cattle they keep are for draught purposes.

The Gavlis, on the other hand, live on the upper hill terraces: Although they practise some shifting cultivation, their main occupation is keeping buffaloes and cattle. They curdle the milk, consume the buttermilk locally and barter the butter for cereals from the Kunbis. As they get their protein supply from butter-milk, they do not need to hunt. Thus, the cultivation of valleys and lower hill slopes is restricted to the Kunbis and of hill terraces to the Gavlis. Maintenance of domesticated animals and exploitation of all fodder and grazing is restricted to the Gavlis and the hunting of wild animals to the Kunbis.

Another instance of niche diversification is provided by the three nomadic hunting communities of the semi-arid tracts of western Maharashtra: Tirumal Nandiwallas, Phasepardhis and Vaidus. The primary occupation of the Nandiwallas is entertainment and fortune telling, that of the Vaidus dispensation of herbal medicines, while the Phasepardhis are specialist hunter-gatherers. Unlike the settled castes, the Tirumal Nandiwallas and Vaidus also hunt in addition to their primary occupation. But the three castes use distinctly different hunting techniques and specialise in different prey species.

The Tirumal Nandiwallas use dogs to hunt wild pigs, large carnivorous mammals (leopard cat, hyena, fox) and aquatic animals (fish, crab, turtle). Vaidus use baited traps for smaller carnivores (mongoose, civet, jackal and cat), monitor lizards and aquatic animals. The Phasepardhis specialise in black buck, wild pig and birds such as doves quails, partridges and peafowl.

Wild meat means a lot to these castes. Gadgil and Malhotra studied the Tirumal Nandiwallas in greater detail and found that the median annual biomass of hunted animal is 2,180 kg per family of Tirumal Nandiwallas, who are thorough in their use of the hunted animals. They even eat portions like the brain and the viscera, normally rejected by other people. Almost two-thirds of the live weight of the prey is consumed. In terms of per capita daily consumption, the median works out to 57 gm of protein and 850 calories from hunted wild meat. For the Tirumal Nandiwallas, the hunted meat provides a more than adequate level of protein and over one-third of the calorific requirements of an average person.

What is striking is that while the hunting techniques used by the three groups are significantly different, none of them are sophisticated that they cannot be adopted by another

**The Lost Tribes**

The story of two nomadic peoples of Rajasthan illustrates starkly the damage that 'progress' can inflict on tradition. The Garuliya Lohars, craftspeople, and the Bhands, travelling artistes, are among the poorest of the rural poor. However unlike the unpretentious landless labourer who can move to the city to find work they have a way of life to be faithful to.

The Garuliya Lohars were originally Rathod Rajputs. During the fighting between the Rajputs and the Bhamanis, they took to forging and casting guns, shields, swords and protective wear. They lived in and around the Chittorgarh Fort enjoying the exclusive patronage of the Ranas. When the fort fell to Akbar, the Lohars vowed not to rest until it had been won back and their nomadism can be traced back to that time.

They carried all their worldly belongings in a cart which had a small place to store their tools. The cart used to cost Rs 500 to build; today it costs anything between Rs 5,000 and Rs 7,000. As time passed, the Lohars changed from specialist gunsmiths and craftspeople to travelling blacksmiths Up to independence they lived through barter and trade: they mended or forged farm and home implements and utensils in the villages; in return they received produce and access to services, those of a midwife, a 'hakim' or a carpenter.

In 1955, Jawaharlal Nehru began moves to rehabilitate the Lohars. He led them in a great procession into the Chittorgarh Fort, and told them that it was now theirs, 'won' back with the coming of independence. But there was no follow-up action for the few Lohars prepared to be rehabilitated and, in fact, most say that after 1955 they have never even been approached by the government.

Today, their plight is obvious. They used to travel in groups of eight to 10 carts; now they move with only three or four, mostly in Rajasthan. Competition from mechanics and welders is crippling.

Their panchayats have deteriorated. Some Lohars may have fled to towns and cities to become part of the anonymous poor Others have given in to the inevitable: in Malpura, one Lohar family has opened a small metal workshop through loans, bidding goodbye to travels and tradition.

The Bhands tell a similar story of misery. They were itinerant minstrels who moved within the kingdom of their patron prince. They were his official entertainers who sang and danced his praises and performed for other prosperous people in the state

Independence shunted them out of their kingdoms and the Bhands became nomads. Today, they travel in the Malpura-Todaraisingh-Jaipur-Kota areas. A donkey or a camel ferries their meagre possessions, and home is a makeshift tent. Their traditional repertoire of songs is in the process of being replaced by 'popular' songs, which the public prefers. They complain that they cannot compete with modern forms of entertainment: their dholaks, shehnais and lyrics belong to another time.

Drink is increasingly a consolation. They beg in towns when they can't find clients, and many of the Bhand women have reportedly turned to prostitution as an additional and sometimes only source of income. Their panchayats might as well not exist. Illiterate, poor, miserable, the Bhands are a forgotten people flung aside by time.

caste. For example, the Phasepardhis could have easily added the Vaidus baited traps to their own shares. But they don't which points to a genuine cultural adjustment.

This division of labour has two important consequences. First, the pressure of exploitation is evenly dispersed over the exploited plant and animal populations. Second, each group is aware that resources in its hereditary territory have sustained it for generations, and will sustain its descendants for generations to come.

### Territoriality

The question of territoriality becomes ecologically significant in the case of pastoral nomads. A study of the shepherd caste of Hatkars, who number 500,000 and are distributed over 19 districts of Maharashtra in the drier tracts reveals a remarkable pattern. Although a large percentage have now taken to settled cultivation, about 18 per cent still have nomadic sheep-keeping as their sole occupation.

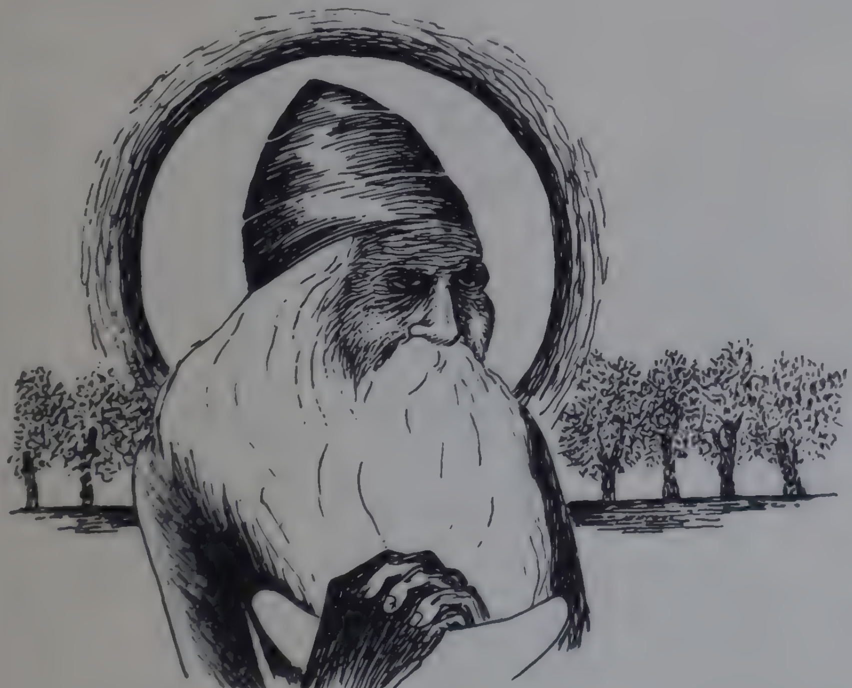
The shepherds spend the rainy season in their base villages and fan out from there to graze their flocks for the dry period. Shepherds from one village operate in a specified territory which does not overlap with that of other villages. The composite territory of a small group of shepherd families is hereditarily determined and may be encroached upon only with special permission in times of serious distress by other shepherd families: even intra-caste competition is reduced.

For instance, village Dhawalpuri of Ahmednagar district comprises four different settlements within a kilometre of each other. While setting out on their migration after the rains, each settlement leaves as a single band moving in a traditionally predetermined direction. As the band moves it continues to split along kinship lines into progressively smaller groups, each moving in its own direction, till the group of families constituting the ultimate unit of the flock reaches its own territory.

This intra-caste territoriality also applies to non-pastoral nomads of the region. Both Tirumal Nandiwallas and Fulmali Nandiwallas make a living by parading the sacred bull, selling trinkets and hunting. Their areas do not overlap. The base village of Tirumal Nandiwallas is Wadapuri in Pûne district, while the 32 base villages of Fulmali Nandiwallas are distributed over the districts of Ahmednagar, Bhir, Aurangabad and Nasik. Both castes spend the monsoon

## Conservative Community

In the deserts of Rajasthan a compact little community practises a religion which can only be called conservation. The Bishnois, as they are called, believe that cutting down any tree or killing any animal is blasphemy. For more than 500 years now, therefore, protecting the environment has been an act of the profoundest piety for them.



These wise people are descendants of Guru Maharaj Jambaji or Jameshwar who was born in 1451 A.D. in Pipasar village in Marwar. When Jambaji was 21 years old the village went through the ordeal of a severe drought. The drought continued for three consecutive years, and as the grass disappeared villagers cut down the remaining trees to feed their animals. Children starved, cattle started dying and in desperation the villagers left their homes in search of water.

Jambaji drew profound lessons from the tragedy: he realised that in the past when there had been a larger number of trees the land had been able to withstand the ravages of drought for a longer period. Because the trees that sustained life had been felled, the people had been destroyed. If life was to flourish again, Jambaji felt that the people would have to recognise the value of their environment — and its importance for their own survival — and adapt their lifestyle to nature.

Jambaji distilled his thoughts into 29 tenets, which gave his followers their name: Bishnois or twenty-niners. The principal precepts were a ban on the felling of any green tree and another on the killing of any animal or bird. The ideas of the conservationist were taken to heart by large number of people in Rajasthan and his basic ethic of respect for all life spread to entire village communities.

Almost 300 years after Jambaji preached his message the faith of his followers was tested. The king of neighbouring Jodhpur, in search for wood to build his new palace, ordered the trees in the Bishnoi village of Khejadali to be cut. The Bishnois protested. When the soldiers paid no heed the villagers, galvanised into action by a woman, Amritdevi, hugged the trees to protect them with their bodies. The king's soldiers attacked and killed Amritdevi, but more and more Bishnois came from surrounding villages to clasp the trees and die. The massacre continued until 363 corpses littered the ground. When the king heard of this he was appalled, and impressed by the devotion and resoluteness of the people, he gave their religion state sanction and ordered that the wishes of this community be respected.

It is perhaps no coincidence that the 200-year old legend of the Bishnoi martyrs finds its echo in the current Chipko movement in the Himalayas. To protect the trees from the forest department's contractors, the Chipko volunteers hug them tightly. Also, as in the Bishnoi story, the crusade involves women.

Today, two and a half centuries and many generations later, the Bishnoi community is intact. The Bishnois continue to protect trees and animals with as much fervour as during the days of Jambaji. Their villages remain green, easily distinguished from others by the abundance of trees, and animals wander around unharmed. Wildlife authorities report that the population of the black buck is noticeably higher near Bishnoi settlements. Says wildlife expert M. Krishnan: "If only official protection was half as efficient and keen-eyed as at these Bishnoi settlements, half our conservation problems would be solved."

Every year, five days before full moon in the month of Bhadrapada, the Bishnois gather at the village of Khejadali for a religious fair. Some years ago they planted 363 trees around that village in memory of their martyrs. There could be no better memorial to their faith.

months in their base villages and spread out during the dry season. Every Tirumal Nandiwalla family had and even today has exclusive rights to visit certain villages. This right is respected by all other families of their caste, and heavy punishment is levied by the caste council for any transgression. The rights are hereditary and may be sold, but only to another family of the same clan within the caste. The Fulmali Nandiwallas have a similar, if less well defined system.

Over the years these pastoral and nomadic castes have developed traditions of prudence in the use of resources. For instance, the Phasepardhis do not kill a pregnant doe or a fawn caught in their snares, which is considered an investment for a future generation. Another example comes from the upper Yamuna valley near Nainital where villagers poison the river upstream with a herb-derived poison which kills fish. This is done just once a year at the time of a communal festival when this fish is fed to the entire community. At other times of the year fish can only be caught with nets; anybody caught poisoning the river is excommunicated. Similarly, a number of groups traditionally consider entire groves and ponds sacred: no plant or animal life in these is allowed to be touched. Some species of plants and animals have survived till today because of such traditions.

**Impact of modernisation**

The traditional rulers of India made minimal demands on wild plants and animals mainly because they got what they needed from collecting the agricultural surplus from rural areas as tax. Only items of special value such as cardamom, sandalwood, musk and ivory came from the wild. A edict of the Maratha king Shivaji dated around 1660 AD forbids the cutting of fruit-bearing trees such as mango and jackfruit for use in building ships for his navy, on the grounds that this would result in considerable suffering for the peasantry in his kingdom. Under such rulers the basic unity of the system survived.

With the advent of British rule, however, greater demands were made on the natural resources of the country—for raw materials for their industrial economy. To avoid having to pay for these resources, vast areas of

## Dying Crafts

Deforestation has many victims. Among the most helpless are all kinds of artisans from basket-weavers to potters who, faced with acute shortages of fuel and raw materials, are having to become agricultural labourers or migrate to the towns looking for menial work.

Thousands of villagers, mainly Harijans and tribals, try to eke out a living by making bamboo baskets, boxes, brooms and mats. But the denudation of bamboo forests caused by paper mills is leading to an acute shortage of bamboo, high prices in the market and severe restrictions on cutting what was earlier a free resource in the forest.

Poor tribal bamboo artisans in Palamau district in Bihar spend much more time now collecting bamboo than before, and also have to do this by stealth and through an organised system of bribery. Middlemen further exploit these unorganised artisans. A local tribal in Palamau who tried to organise the artisans provoked the local forest staff so much that they had him beaten up mercilessly in full view of the village and a police complaint was registered against him for manhandling a forest official.

The plight of Saharanpur's baan makers — nearly 40,000 families — is equally pitiable. Baan, a kind of rope, is used in charpoys, rope bed and is twisted and woven from bhabhar grass *(Eulaliopsis binata)* which grows naturally in the forests of the Sivalik foothills. For generations the bann makers collected the grass themselves. But in 1951 the government brought all forests under its control and only contractors were allowed to cut the grass, jacking up the price.

The entry of the Uttar Pradesh Forest Development Corporation in 1982 as the sole seller of forest products, a step supposed to squeeze out the contractors, only introduced yet another middleman. The raw material's quality deteriorated, prices shot up even though paper mills continue to get bhabhar at extremely low rates. Today thousands of baan (rope) makers are being forced to sell firewood as headloaders, work on gangs breaking stones for road-building or keep animals. Vikalp, a social action group, is trying to organise them into a cooperative.

India's 15 lakh potters face a similar crisis in raw materials. The cost of clay and firewood has shot up. Given the inroads made by glass and aluminium products, potters are being completely squeezed out. Earlier many potters would have Jajmani relationships with peasants, blacksmiths and carpenters: the peasants would give clay, blacksmiths would repair the iron implements, and the barber would shave freely in exchange for earthen vessels. In many villages, the first right to wayside dung would traditionally be that of the potter.

But now land has become a valuable commodity and clay is no longer easy to get. With the firewood shortage, dung is extensively used as fuel. The owners of clay and dung now prefer to be paid in cash. Modern utensils are preferred to traditional earthen pots: for instance, with milk being increasingly sold to milk cooperatives, milk producers no longer use earthenware. A majority of potter households in Gujarat villages have taken to non-agricultural occupations in towns and to some extent in villages.

Potters in towns and cities are faced with equally daunting prospects, especially as deposits of clay get covered with concrete housing structures. The famous mud toy makers of Lucknow told India Today that housing authorities have made no attempt to protect deposits of Kali matti (black soil) from which they make their toys. Says Chhotey Lal, a well-known clay bird-maker: "Even when we all get together, the four members of my family cannot make more than 200 birds a day, which will sell for a mere 10 paise to 12 paise each. This leaves us with a profit of not more than Rs 8 a day, no matter how hard we work."

In the Lucknow locality of Talkatora lies a good deposit of black soil and despite repeated pleas by the Uttar Pradesh Prajapati Navyug Sabha not to encroach on this area, the housing authorities bash on regardless. The rising land rent of the Talkatora plot is squeezing out the toy makers. In the last 10 years, the number of crafts people has gone down from 1,200 to 800 in Lucknow.

The famous clay modellers of Kumartuli in Calcutta, well-known for their magnificient Durga idols, live herded into small, cramped rooms, but are not prepared to leave Kumartuli because clay, their principal raw material, can be collected in abundance from the nearby Ganga. The state government had proposed that they move to Salt Lake City and better conditions. But the artisans feared that transport costs of their raw material would go up and so would the prices of their Durga idols, which already sell for between Rs 700 and Rs 3000 each.

Many ancient crafts are already dead. In Palamau, tribals used to collect wild cocoons from trees and tribal women would roll silk yarn out of these cocoons on their thighs. The yarn, called ghicha, was in appreciable demand in silk centres such as Bhagalpur and Varanasi. But wild cocoons are now rare and this practice has died. Unless something is done, other crafts will soon meet the same fate — India will be a country of many dead crafts.

communal land were declared government property. These resources were rapidly depleted through commercial exploitation, a trend that has accelerated since independence and has led to considerable impoverishment and often a complete collapse of the natural resource base. The cash economy, which is replacing the traditional barter trade, is destroying traditional relationships between various castes and increasing competition and tension amongst them for limited natural resources. Population growth in the Western Ghats has also been an important factor in increasing the pressure on the land, especially after the 1920s with the control of epidemic diseases such as influenza and plague.

The consequent deforestation and soil erosion in recent years have destroyed the fodder base of Gavli animals. The Gavlis, pastoralists by tradition, have been forced to reduce their animal holdings and take increasingly to cultivating more land on the hill slopes. This has prompted them to try and purchase land from peasants and become more sedentary. In the process they have also changed their lifestyle. While earlier their houses were made of bamboo and thatch, compatible with frequent shifts, now they build more durable houses with large timber beams and poles, metal or tile roofing.

In earlier times the Gavlis mostly kept buffalo because there was an adequate fodder base and shade provided by thick forest. In recent decades they have turned to keeping cattle and now goats. Goat-keeping is a phenomenon of the last two decades, indicating the accelerating rate of deterioration of tree growth and fodder base. The forest is being cut for a variety of commercial purposes, including charcoal for urban areas. Even the trees that were traditionally conserved by the Gavlis in the tracts where they practised shifting cultivation have now been cut.

The resulting degradation of the environment cannot support animal husbandry as practised traditionally by the Gavlis. These people curdled and converted the milk from their cattle to butter mainly because they lived away from villages and did not have the means to transport and sell milk to the settled population further afield. They could get grain by bartering their butter. Today, however, the Gavlis market their milk through cooperative societies set up to supply milk to urban areas. The thrust of the dairy development schemes is to tap milk from rural areas and deliver it to urban areas. The infrastructure of truck routes, chilling plants and power plants is geared to this end; no consideration has been given to improving the fodder base, health or genetic quality of the milk-producing animals.

Furthermore, the Gavlis have started to market all their milk, denying themselves the protein in their diet provided by buttermilk. The 150 per cent increase in their cash income is not being used to supplement their diet. Instead it

**Tribal women selling brooms: raw materials even for artisanal occupations are becoming scarce and expensive. (Bhalu Mondhe)**

**A Gavli with his huge buttermilk churner. But now their buffalo-herding days are numbered. (Kailash Malhotra)**

is being used to meet entirely new wants of expensive clothing, housing and so on that have arisen from being part of the market economy and from contact with urban culture. To meet their nutritional needs the Gavlis are cultivating more land, even steep slopes that were kept for fodder. While marketing the milk, the calves are not allowed to suckle as before, thereby stunting their growth, delaying the age of reproduction and worsening the fodder to milk-conversion ratio. The changeover to goat-keeping is also accelerating the degradation of the vegetation.

Many Kunbis, too, have lost their fertile paddy fields to river valley projects and have been pushed up the hills. Their prey has also dwindled with deforestation. Where they used to get a deer or wild pig every week, they now barely get a black-naped hare once a month. The urban milk schemes have lured Kunbis into keeping milch animals and, therefore, they are no longer willing to let Gavli animals graze in their fields after harvest as they did before. All of this has led to serious conflicts between Kunbis and Gavlis, often forcing the numerically weaker Gavlis to abandon their traditional occupation and locality.

The Gavlis have experienced a drastic shrinkage of available territory. At first they began to intensify the shifting cultivation of the hill plateaus and upper hill slopes. Because they had traditionally not established ownership rights over land, this meant encroachment on government-owned forest land and conflict with government officials. When this option had run its course, the Gavlis began to move out of the area. With the control of malaria in the still forested areas of the Western Ghats of Karnataka, an estimated 15,000 Gavlis moved there between 1945 and 1960. Many others began to accept other non-traditional occupations in nearby areas, such as gardening, tailoring and bicycle repairing, especially near the hill resort of Mahabaleshwar in Satara district. Finally, an estimated 8,000 Gavlis migrated to cities like Bombay and began work as unskilled workers, visiting their families once or twice a year. Several hundreds have joined the army.

Another example of a group marginalised by the degraded environment is the Phasepardhis. This hunting-gathering tribe generally stayed aloof from settled villages; sometimes farmers asked them to snare a black buck, deer or any other animal raiding their fields. In recent decades the main prey of the Phasepardhis have either been decimated, or hunting them has been declared illegal as in the case of the blackbuck. The Phasepardhis have taken increasingly to theft, prostitution and begging, and now live in a tense relationship with the settled community.

The Vaidus, too, have witnessed major changes because of modernisation. Over half of them have given up their traditional occupation, moving to cities like Bombay, Pune and Kolhapur to work as wage labourers, or to take up petty manufacture, mend tin boxes, sell trinkets, and catch and sell snakes. The major reason for their social decline has been the primary health care centres and the spread of allopathic medicines, resulting in a drop in the demand for Vaidu medicine. Those that continue to practise their traditional occupation have started keeping some allopathic medicines, and are labelled by modern doctors as quacks.

Rigid, hereditarily determined and hierarchical it undoubtedly was, and is, but India's much-maligned caste system had quite definite advantages, as the exhaustive study by Gadgil and Malhotra demonstrates. Today, with the onslaught of modernisation, the system is but a shell of its historic self. But the fact that it is now just an excuse for social oppression should not blind us to the realisation that it played a crucial role in preserving India's natural riches for centuries.

## SHIFTING CULTIVATORS

It is more than an occupation, it is a lifestyle. Shifting cultivation (jhum) is a form of farming where a forest is cut, the dried biomass burnt, the land mixed-cropped for one or sometimes two years and then left fallow so that natural vegetation can return and the soil's fertility restored. The farmer meanwhile moves on to another patch of forest.

Shifting cultivators have been called the scourge of forests and shifting cultivation a major cause of soil erosion. The UN study on Tropical Forest Resources of Asia says that a logged area becomes deforested only when shifting cultivators move into a logged area — for the study, commercial logging is not deforestation.

This is an extremely dishonest appraisal and demonstrates the bias against shifting cultivators, all of whom are tribals. However, many Indian foresters themselves point out that shifting cultivation was a remarkable innovation for primitive cultures making the revolutionary transition from food-gathering to food production. "Even in the modern age, in areas which are inaccessible by current standards, where only village or tribal barter non-monetised economy prevails, the cultivators have to be largely self-sufficient and have to produce almost the full range of their requirements in the shape of food, clothing etc. This is how mixed cropping for a self-sufficient subsistence economy developed and still thrives where there is a strong and ancient tradition of Jhum," says former Inspector General of Forests S.K. Seth.

In India, shifting cultivation is practised in about 228 development blocks — spread over 53 districts — out of a total of 5,123. These blocks are concentrated in the Northeast and cover all of Arunachal Pradesh, Meghalaya, Mizoram and Nagaland, five hill districts of Manipur, and two districts of Assam.

A UN study found that in 1971-75 there were slightly less than three million people primarily or partially dependent on shifting cultivation and the estimated area on which this type of farming was practised for a year was a little less than one million hectares. The survey excluded data from 14 blocks in nine districts of Karnataka, Kerala, Maharashtra, Madhya Pradesh, and Sikkim where Jhum is practised very marginally.

But this is not the entire area affected by shifting cultivation. For instance, data presented to the National Commission on Agriculture shows that in the seven North-eastern states, 492,000 tribal families practised Jhum on 453,000 hectares in one year. The total area used by these families over the total shifting cultivation cycle was 2.69 million hectares.

Shifting cultivation is mainly practised in the medium to high rainfall zone (2,500-10,000 mm) and on hilly slopes generally between 100 metres and 1,200 metres but in parts also extending to 2,000 metres. The population density in these areas is generally low in comparison with the rest of the country, but there are substantial variations. The lowest density of three persons per sq km is in Arunachal Pradesh, but in parts of Tripura and Orissa the density is often over 300 per sq km. Usually, in areas where the population density is below 30 per sq km, people are primarily dependent on shifting cultivation: this is especially true in

## Tribal Trauma

Banswara is the southern-most part of Rajasthan, predominantly tribal and very different from the deserts of the rest of the state. The area is hilly and undulating and once upon a time it was completely covered by lush, dense teak forests of which very little remain. The adivasis who live here belong to the Bhil tribe

In Banswara (Peepalkhunt Block), there is only one major forest left, which is under the strict control of the Rajasthan forest department. All the adivasis in this area are now settled agriculturalists. Each tribal family in Peepalkhunt now has about 5 bighas to 10 bighas of land. Most is unirrigated and is staked out on hill slopes. The land at the bottom of the hills is extremely fertile and every adivasi tries to acquire a strip here, along with the less fertile land on the slopes. There is just one major crop a year, the kharif crop. The average family harvest provides support for about three to four months in the year. The rest of the time the adivasis must migrate as labour on dams or on contruction sites.

The pressure on land is tremendous as with each generation land holdings grow smaller and less viable, and work is more and more difficult to find. The harvest in October is a time for rejoicing as there is food to eat at last, and the storage bins are full. But as December approaches, the storage bins are almost empty, and by March prospects are grim. The long, hot summer months have to be faced and survived somehow. Then, the weather breaks and the rains bring fresh hope, but the tribals are lucky if they eat even one square meal a day. Year after year, this is the pattern of their lives.

The adivasis still depend on the forest for survival, even though they are now considered an intruders there. Whenever a tottering beam or post is to be replaced in the hut, the tribal family sneaks into the forest to cut a branch. To protect the precious crops, the tribal again has to sneak into the forest to cut poles and get bramble for a fence. When the tribal has to make a plough or some other farming tool, it has again to be done like a thief.

Finally, when the family has starved for two days, and there is no hope of getting any food or employment or a loan, the tribal family goes into the forest at night where they cut headloads of wood, walk 60 km to the nearest town, sell it at half the price, buy grain at double the price and walk back to feed their children. Once the tribals had easy access to wood for all their simple needs; now they have to do it by stealth and as criminals.

Even though the Indian Forest Act says that tribals and anyone living near forests may use the forest for housing, fencing, agricultural implements and firewood, in actual practice the forest department refuses to implement this provision. Any tribal caught in the forest is beaten up ruthlessly and fined, often on the slightest pretext or suspicion, to teach someone a lesson.

Unfortunately, the present custodians are responsible for the devastation of the forests. No contractor can cut trees without the connivance and the participation of forest officials and forest officers have found their posts extemely lucrative over the years.

In village Ghantali and in all the villages around a great deal of tension already exists between the forest department and the adivasis. The forest departments now receive funds for planting saplings, but this only aggravates the situation as they are fencing off every bit of available and open land, leaving no area for the adivasis to graze their cattle. Forest guards and tribals clash every day, with stories of cattle having broken down fences, trampled eaten saplings and caused general havoc. The adivasis find their cattle confiscated, and can only get them back by paying large sums of money. There are complaints that the guards round up cattle that are nowhere near the fences, in order to levy charges and make some money.

Here are a few cases of excesses. On August 12, 1982, Kaliya, resident of village Ranpur, Peepalkhunt Panchayat Samiti, was forcibly dragged to the Nayan Forest Chowki by the forest guards, where he was hung upside down and beaten with lathis. He was finally rescued by some neighbours. Later he was fined Rs 150 for grazing cattle inside the forest boundary and damaging saplings; Kaliya denies this charge. A receipt was given to Kaliya by the forest guard, not for Rs 150 but for Rs 51 (receipt no. 5116 dated August 12, 1982).

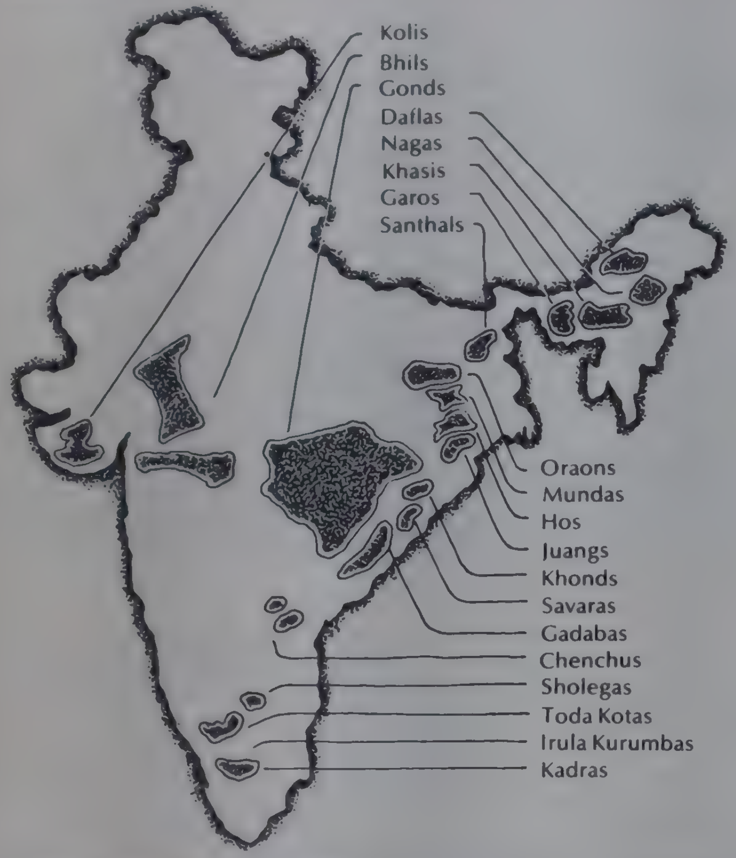
On July 29, 1982, Onkar, resident of Ghantali, was accosted by forest guards while he was collecting dry fencing material from the forest. He was beaten up by the guards and his axe confiscated. He will have to pay to get it back. An axe is a very precious and useful implement in the adivasi household, and its loss is always felt.

On February 16, 1982, Ramla, resident of Mandli Pada, Ghantali was beaten up by forest guards who said his goat had eaten up a thousand saplings in the forest. The goat was confiscated and the guards demanded Rs 1,500 before they would return it. On November 24, 1982, forest guards stopped Rathni, wife of Lakshman, resident or Karmoda while she was taking home a bundle of firewood. She was pushed and abused in filthy terms. Her thumb impression was forcibly put onto a piece of paper she did not understand and the guards demanded Rs 100 from her.

The stark fact is that no forests can survive if the local people are not involved. Few programmes genuinely take the interests of the tribals into account. The tribals have had a raw deal both ways: victims of the deforestation caused by modern India and of the new afforestation programmes.

## Tribes of India

Tribal populations of peninsular India fall into three main geographical clusters. The larger cluster consists of the central Indian group such as Bhils, Gonds and others spread over extensive areas of deciduous forests. The eastern Indian group includes the Munda-speaking populations—Munda, Ho, Savaras, Santals—of Orissa and Chotanagpur area, located within the evergreen sal forest area. The third and smallest cluster consists of populations belonging to south India located in the Eastern and Western Ghats, south of the river Krishna.



Some of the major tribes can be classified as belonging to four broad regions and the three main occupations of food gathering, shifting cultivation and settled cultivation.

Most existing food gatherers live in south India along the ghats. One such group, the Chenchus, who are 27,000 in numbers, live on the Nallamallai hills of the Amrabad plateau in Andhra Pradesh which stretches on both sides of the river Krishna, and are isolated geographically from the rest of the food gathering groups of south India.

The Telugu-speaking Chenchus' lifestyle has changed drastically: in the 1940s, their bows and arrows ensured them a regular supply of meat. Later, when large-scale hunting thinned game, they turned to roots, tubers, vegetables, wild fruits, berries and honey. They even bartered jungle produce with Hindu peasants on the forests' edge. The Chenchus live in wattle shelters; in the hot season, families combine to roam in search of food. Each village owns a tract of land which is the common property of its members. However, they lack a tribal organisation to coordinate them for social, ceremonial or religious purposes.

Two other food gathering groups are the Kadars and Malapantaram, both living in Kerala's hills. The Kadars were food gatherers and hunters until the 20th century's first quarter, only occasionally turning to barter. The iron-tipped digging stick is an important tool for them, being used to dig up their staple food roots and tubers. They hunt deer and smaller animals using dogs, catch fish by poisoning dammed pools with poisoned bark and smoke out bees to collect honey. The Malapantarams are dispersed over the Pathanapuram and Koni hill ranges of south Kerala. Their traditional lifestyle is similar to the Kadars but, unlike the Chenchus and the Kadars, they are trappers as well. They, too, by 1953, had moved from subsistence food gathering to systematic gathering of marketable forest produce for purposes of barter.

### Shifting cultivators

Shifting cultivators form 12 per cent of the tribal population. A large proportion of them exist in northeast India, but are also found in the highlands of southwest India and in central India.

Some shifting cultivators living in Kerala and adjoining areas of Karnataka are the Jen Kurumbas, Bette Kurumbas, Uralis, Ulladans, Kanikars and Palliyans. Most still depend heavily on food gathering. However, unlike them, central and east Indian tribes live fairly adequately by food gathering. The tribes who are still relatively undisturbed, like the Hill Maria Gonds—in Bastar district, Madhya Pradesh—Baigas and Juangs in Madhya Pradesh and Orissa—have a self sufficient economic base. Their main occupation is agriculture. For the Baigas of Madhya Pradesh shifting cultivation has virtually become a cult.

Shifting cultivation can be quite satisfying in the hills of the northeast, for populations like the Konyak Nagas, the Garos and the Nishis. The Konyak Nagas inhabit Nagaland's extreme northeastern corner; traditionally head-hunters, their villages resemble fortresses, surrounded by sharpened bamboo-staves. The villages are permanent and there is individual ownership of land. The Garos inhabit the greater part of Garo Hills in Meghalaya, and tend mixed crops on hill slopes. They have no permanent individual ownership of land: plots are distributed to families by the village head in consultation with the villages.

### Settled cultivators

Many of the more numerous and economically better off tribal populations were settled cultivators. In central India, the two largest groups are the Bhils and the Gonds, and in eastern India, the Santals and Oraons. Their main crop in central India was millets, and rice in east India. Now the very existence of these tribes is threatened because they own fertile lands coveted by advanced Hindu peasants.

Among the more prominent of these tribals are the Raj Gonds, numbering 100,000 and spread over Maharashtra and Andhra Pradesh. They had kingdoms from the 14th to the 18th century, when the Marathas conquered them. They have a rich cultural heritage and poetry as, indeed, do the Santals of east India, whose principal crop is paddy. They began losing their lands to non-tribal immigrants in the mid-19th century and their grievances burst out in a massive uprising in 1855-56. The eastern group has today formed the Jharkhand party which demands a separate tribal state.

### Review of tribal development

In 1954, 43 special multipurpose tribal development blocks were started for tribal areas. By the Third Five-Year Plan there were 500 of these, covering 40 per cent of the tribal population. The programme did not spread further because it was seen that the articulate and better-off sections took the lion's share.

The Fourth Five Year Plan envisaged a shift in strategy, establishing tribal development agencies—six in the fourth plan, with two added in the fifth—each covering a group of blocks. Set up to begin economic development and provide social services, in actual practice they stressed agricultural development and investment in roads.

The fifth plan saw yet another strategy shift. There were two strategies, one for areas with 50 per cent or more tribal population and another for dispersed tribal populations. The former were brought under the Integrated Tribal Development Project (ITDP). By 1978 there were 180 ITDPs. The end of the sixth plan should see 80 per cent of all tribals covered under the programme.

Between 1978 and 1983 there was at least Rs 3,000 crore available for tribal development. But economic development by itself is not enough, as the powers-that-be have realised: the tribals must be protected against exploitation. They must also be educated so that they are able to face the modern competitive world on its own tough terms. Unfortunately, there seems to have been the usual gap between intent and implementation, a gap which should be filled as soon as possible if some of India's oldest communities are to survive and thrive.

Northeastern states. But in areas with a higher population density, people have other occupations like animal husbandry, household industry and collection of minor forest produce.

In most cases the land is community property, the household having usufructuary rights over its allotted patch as long as it cultivates it. But after it is vacated the land returns to the community. This is not always so. The Bondas and Saoras of Koraput and Ganjam districts recognise individual ownership of hill clearings. Among the Saoras, a hill slope suitable for shifting cultivation may even pass on from father to son and this has created problems of fragmentation. A third system operates amongst some Nagas and the Kukis of Manipur, where all the land is owned by the chief or the clan, who then distributes it to individuals.

The tribals have a keen sense of ecology. Fruit and other useful trees are seldom burnt. In Madhya Pradesh, the Abujhmar tribes leave the mohua trees standing as they eat their fruits. In Andhra Pradesh, toddy palm, tamarind and mango trees are left standing in the Arakku valley. In Nagaland alder trees are pollarded and left. The Noctes and Nissis of Arunachal Pradesh use *Macaranga denticulata* for small timber and firewood. If these trees are absent, they sow their seeds when vacating the land for regeneration and in places these areas look like plantations of *Macaranga.* The fallen leaves from the trees left standing also act as compost. Some shifting cultivators even worship the trees.

### Shortened Cycles.

As long as the cycles are long enough, the practice is excellent. Unfortunately the desirable former 20 to 30 year cycles have shortened to 4 to 5 year cycles in the recent past, radically so in the Northeast.

With the burning of the forest, the original forest never returns. Instead, bamboos, reeds and other coarse grasses usually take the place of evergreen shrubs: witness the bamboo forests in the Northeast and in peninsular areas such as Abujhmar of Madhya Pradesh.

Shifting cultivators prefer bamboo's secondary growth to a primary or a secondary tree forest as it is much easier to cut, dries rapidly and burns well, yielding plenty of potash-rich ashes for a successful jhum crop. But with the shorter jhum cycle, weeds like *Eupatorium* have spread widely in places like Meghalaya (Garo Hills). *Eupatorium* tends to check the growth of coarse grasses like *Imperata cylindrica* but once *Imperata* invades a badly degraded land, restoration of forest cover is extremely time-consuming and expensive, even impossible.

Smitu Kothari

The shortening of the jhum cycle is definitely a reason for soil erosion. But the soil degradation taking place because of this distorted version of shifting cultivation today has little to do with the practice itself. The degradation as a result of shifting cultivation depends on a number of factors. The increase in population density is definitely a factor in reducing the period of the jhum cycle but as surveys show the number of people dependent on shifting cultivation does not appear to have increased dramatically during the '60 s and '70 s.

The biggest change has been brought about by the change in economic circumstances, which have made wood and former weeds like bamboo into a resource desired by more powerful sectors of the society, which see the burning of valuable wood and bamboo mainly for its fertiliser value as extremely wasteful. Seth gives an example: "The erection of the Nagaland paper mills in the midst of the extensive bamboo forests which have sprung up as a result of past and recent jhum, has made bamboo a much more valuable industrial crop than any fertiliser that could be obtained by burning it. Further, bamboo clumps have to be preserved and not destroyed in the interest of sustained production of raw material to feed the paper mill. One sector of the economy has therefore become industry-oriented and the evaluation criteria (for forest resources) are correspondingly altered."

Government agencies have made many vain efforts to control jhum and resettle shifting cultivators. But the programmes have left problems in their wake. Urmila Pingle, a medical anthropologist who has spent a decade in research work on the central Indian tribal population, and her colleagues N.V. Rajareddy and Christoph von Furer Haimendorf have published a report on the misery caused by the banning of shifting cultivation among the Maria Gonds in the Abujhmar Hills of Bastar

In village Binakonda, which the researchers first visited in January 1978, they found the Marias very reluctant to adopt settled cultivation. They knew that successful wet rice cultivation in terraces would yield more but they would also need more inputs, new tools, and all this could make them much more dependent on totally undependable government aid. By contrast, all that they needed in shifting cultivation was an axe and muscle power.

When Pingle and her colleagues visited Binakonda again in 1981, they found that shifting cultivation had been stopped by the forest department using the threat of fines. Some villagers had been fined Rs 60 per person by the local court for having cut down new patches of forest. The shifting cultivators had been forced to select lands for rice cultivation and build bunds at their own expense. They had taken the advice of the Maria Gonds in the plains and had sown the first paddy crop with purchased seed. The promised government help never came through and poor rains and disease meant that not enough food was produced to last even two months.

Fortunately, Binakonda households were able to find manual work with the help of relatives in neighbouring villages and this helped them through their crisis period and prevented them falling into the clutches of non-tribal money lenders. Some families did have to borrow foodgrains from their kinsfolk in Bastar. Some tribals had also started working in nearby coffee plantations or had become involved in cutting bamboo. Wages were seldom paid promptly and were usually less than those paid to outside labour. A household survey revealed that the tribals had to make do with less grain and were supplementing their food by collecting wild green leafy vegetables growing near the streams.

In contrast, when the same team visited other hill Maria villages like Sonpur and Handewada, where the tribals have been left in comparative peace to follow shifting cultivation, they found the Maria communities stable and happy. This area was regarded as protected territory and paper mill contractors were debarred. The Narainpur market, an important market for the hill Marias, was being run for and by the tribals. Here the tribals were fully aware of the market values of daily commodities unlike in nearby markets which were controlled by Telis and non-tribal money lenders.

**Cultivation constraints**

The government has been toying with the idea of banning jhum. Warning voices have been raised against such a step. The Committee of Forests and Tribals in India set up by the Home Ministry, which included many senior foresters and was headed by Professor B.K. Roy Burman, said in its report submitted in 1982: "Such a step is not likely to achieve the object in view; it might even provoke reaction."

A nationwide ban on shifting cultivation does not exist, but foresters' attitudes and regulations vary. For instance, within Madhya Pradesh, the people in the Abujhmarh block of Bastar district are relatively free to practise shifting cultivation but it is not permitted in the rest of the state. Each state or union territory of the Northeast has some programme of jhum control, either as a special programme or as a part of a programme of the Department of Soil Conservation.

A number of factors have led to the failure of schemes to settle shifting cultivators. The new settlement disrupts their socio-cultural life abruptly. The tribals are not used to cultivation of terraces using bullock-drawn implements. The production technology for terraces, water management and water conservation practices have not been properly developed for the regions in which shifting cultivators live. Production is generally low on the terraces in the first year because of the removal of topsoil when the terraces are made. Even under irrigated conditions but without adequate fertilisation, permanent cultivation is rarely feasible economically.

For this reason, even where terraces have been made with government aid, the families settled there have abandoned them after a short period, as low capital availability, high labour input, changed social structure and low yields proved very discouraging. Most important of all, government assistance has to be long term till the new economy of the tribals stabilises, and has to be provided with promptness and in time, something alien to callous government agencies.

Roy Burman and P.S. Sharma, in a paper on tribal agiculture in India, document the causes in telling detail: allotment of poor quality land to tribals: the forest department did not release land in time, even after the tribals came to stay in colonies; there was no facility for minor irrigation and the tribals were given no means to support themselves until the next crop was raised; the reclamation subsidy and grants for purchase of agricultural equipment were rarely made available in time; the physical structure of the houses supplied to the tribals did not meet their social and cultural needs; and, in some cases where colonies were made up of tribals from different areas, these colonies failed to acquire cultural homogeneity.

Saora leaders told a team of experts recently that they were ready to cultivate terraced fields but they also needed hill slopes for shifting cultivation. Shifting cultivation helps them to produce 10 to 11 varieties of crops, of which millet is the most important. But in a terrace system, the entire cropping pattern will change, rice cultivation will dominate, and this will affect their pattern of food consumption.

Certain Naga tribes, who have practised irrigated cultivation extensively for centuries, have not yet abandoned jhum totally. They have tried to improve their permanent cultivation by burning the undergrowth in a method which resembles jhum.

The system which is finding most favour amongst officials is to develop the lowest one-third of hill slope into irrigated, fertilised and well-maintained terrain, put the middle-third under horticultural crops interplanted with grasses or legumes like cowpeas and the top third under forest. With the help of fodder generated by the middle tier and some controlled grazing in the forest, animal husbandry can also be integrated with this system. The Roy Burman committee also felt that afforestation based on an agro-silvicultural system might meet the psychological urge of tribals to practise shifting cultivation. The committee recommended that "a 10 year perspective plan may be prepared for settlement of shifting cultivators as per this three-tier agro-silviculture pattern".

Pingle and her colleagues strongly condemn forest officials who coerce tribals into changing over to settled cultivation and argue that any change will have to be gradual and financial and technical support must be provided towards a smooth transition. The foresters should not consider shifting cultivators encroachers. The Marias in Bastar district, for instance, have been cultivating their lands from time immemorial and thus have fundamental rights to the territory; moreover the forest department does not even have any legal standing in the area as no reserved boundaries have ever been fixed.

The researchers also warn that settled cultivation will breed individualism and destroy village unity, a useful and necessary social security system which has developed over centuries and is closely linked to shifting cultivation as a means of production. In Assamese, jhum means collective. It is imperative, whatever changes are made in a farming lifestyle that has endured for centuries, to preserve the cohesion of the village, its independence and its self-respect, so that the cooperative spirit which fostered such wise use of the soil and the trees is not rubbed out.

# WOMEN AND NATURAL RESOURCES

Probably no other group is more affected by environmental destruction than poor village women. Every dawn brings with it a long march in search of fuel, fodder and water. It does not matter if the women are old, young or pregnant: crucial household needs have to be met day after weary day. As ecological conditions worsen, the long march becomes ever longer and more tiresome. Caught between poverty and environmental destruction, poor rural women in India could well be reaching the limits of physical endurance.

Biomass plays a crucial role in meeting daily survival needs of the vast majority of the rural households in the country: food, fish, fuel (firewood, crop wastes and cowdung), fodder, fertiliser for agricultural fields (cowdung, organic manure, green mulch and forest litter), building materials (timber and thatch) and medicines (herbs), are all different forms of biomass. Water is another crucial element in human survival and its availability is definitely related to biomass in a country where rain falls only four months in the year. When the biomass in the surrounding environment disappears, water sources like streams and ponds also tend to disappear soon after the monsoon. An important aspect of this biomass-based subsistence economy is that it is mostly non-monetised. Water, fuel, fodder, building materials and even food to a certain extent are all gathered freely from the immediate environment. Production and processing of biomass — agriculture, forestry and village crafts based on biomass as raw material are also the biggest sources of employment.

Unfortunately industrialisation, urbanisation and the advance of the cash economy have greatly affected the country's biomass base. The destruction of biomass with deforestation and devegetation — and its transformation away from rural and household needs and towards urban and industrial needs (planting of teak or eucalyptus in place of sal or other natural vegetation, for instance) — is having a major impact on the lives of all those who live within the non-monetised, biomass-based subsistence economy. Marginal cultures like that of tribals and nomads are the first to face total social destruction. But women, not only within these cultures but in all rural cultures, face the maximum threat.

The special difficulties that women face — their extraordinary work burden or lack of access to health care, for instance — do not arise out of ecological deterioration per se. They are located in the sexual division of labour, marked by a double work burden (at home and outside) and by the specific nature of tasks they do, and in the unequal distribution of resources like food within the household, which stems from womens inferior status in the household and from a lack of control over cash and productive resources like land. But given this situation, environmental destruction exacerbates women's already acute problems in a way very different from men.

## Long hours

The culturally accepted division of labour within the family leaves the collection of household needs like fuel, fodder and water to women. As these become increasingly difficult to obtain, women have to spend an inordinate amount of time foraging for them and all this has to be undertaken in addition to household work — cooking and child rearing — agricultural work and caring for animals. Increasing poverty, transformation of agriculture and male migration may be worsening the situation even further in many areas.

**Select statistics about women and men**

| | Females | Males |
|---|---|---|
| Total number (millions) | 318 | 340 |
| In urban areas | 73 | 83 |
| In rural areas | 245 | 257 |
| Sex ratio (no. of women per 1000 men) | 936 | 1000 |
| In urban areas | 880 | 1000 |
| In rural areas | 954 | 1000 |
| Total workers (millions) | 66 | 181 |
| Main workers | 46 | 174 |
| Marginal workers | 20 | 7 |
| Work participation rate (%) | 21 | 53 |
| Main workers only | 14.4 | 51 |
| Distribution of main workers | | |
| Cultivators | 15 | 76 |
| Agricultural labourers | 21 | 34 |
| Household industry | 2 | 7 |
| Other workers | 8 | 57 |
| Literacy (%) | 25 | 47 |
| In urban areas | 48 | 66 |
| In rural areas | 18 | 41 |

Source: Registrar General of Census, 1981

Available studies show that rural women work longer hours than men. In Pura, a village situated in the plains of Karnataka, women contribute 46 per cent of all the human-hours spent in the village on agriculture, industry and domestic work, men 37 per cent and children 17 per cent. But in domestic activities alone, women contribute half the total human-hours spent, men and children about a quarter each. Women spend nearly 90 per cent of the time spent on cooking, nearly 80 per cent of that spent on fetching water and nearly 40 per cent of that spent on collecting firewood, and all the time spent on carrying food to the farm. Nearly half the time of the households — chiefly of women and children — is spent on basic activities like fetching fuel and water and cooking food. This can take as much as 7.5 hours daily per household and in poorer households it can be as high as 10 hours. A study from the plains of western Uttar Pradesh, an agriculturally prosperous area, shows that even pregnant women there spend a 14 to 16 hour working day.

This is how one village woman described her life: "This is the seventh month of my pregnancy. I am the only adult in the household to take care of my children, two buffaloes and a calf. My husband is a petty trader in a nearby town. The entire responsibility of the house is on my shoulders. I have to cook, fetch water and provide fodder to animals. In the evening I take them for grazing and collect green fodder. I also have to supervise the ploughing ... where is the time for me to take rest ... I usually resume my normal activities just four to five days after delivery."

But women's problems are usually ignored by experts. Srilata Batliwala a nutritionist working in the slums of Bombay, argues that the current concern over the shortage of cooking energy, for instance, has arisen more out of the environmentalists' concern for deforestation rather than a concern for women's problems. "Startling figures about the rate of deforestation are bandied about—occasionally the analysis even comes down to the energy problems of the poor. But the real human face of this crisis is the face of women—a fact not brought out except rarely," says Batliwala.

Equally surprising is the fact that even some of the best studies on women have failed to show how closely the lives of rural women revolve around the availability of natural resources and how the destruction of those natural resources bring about extremely harsh and immediate problems. The well-known report of the Committee on the Status of Women in India, for instance, makes almost no mention of the increasing problems faced by women in collecting fuel, fodder and water. The Women and Development chapter in the Sixty Five Year Plan document, praised for being the first such chapter in India's plan documents, also makes no mention of women's problems in meeting daily biomass needs. Yet as the protests of the Chipko women show, there could probably be no immediate problem that is more pressing.

## Household fuel

Collecting fuel is an important daily chore for most rural women. In Pura, to gather 1.74 tonnes of firewood every year, each firewood gathering household spends an average of 2.51 hours daily, makes 172 trips in a year and each round trip is about 8.54 kilometres.

In several north Indian households, there is greater reliance on cowdung than firewood. But this does not necessarily reduce the time spent by women. A study carried out on the health of pregnant women in two villages in western Uttar Pradesh show that women spend long hours in animal husbandry and making dung cakes. For instance, one pregnant woman spent a 14-hour working day, in which three hours went on animal husbandry and half an hour on making cowdung cakes. In addition, this woman spent three hours on fetching water, 2.5 hours on cooking and five hours on other household chores, including milling grain.

Women's work in the hills and deserts is even harder. Agricultural production in these areas is extremely limited and alternatives to fuelwood like cowdung and crop wastes are also limited. Available studies clearly show that women put in an inhuman amount of time in the hills and deserts just searching for fuel and fodder. Madhura Swaminathan, in a study of an Himalayan village Dwing in Chamoli district, Uttar Pradesh, points out that one or more members of each household daily walk 5 km steep uphill and spend six to 10 hours on the job. The average daily time spent by each household is 7.2 hours. An old widow often takes up to 10 hours. Wild animals are a constant danger and two people generally go together. In 75 per cent of the households, only women go out to collect wood. Generally three trips are made every four days though many women go daily.

Pakhi is a fairly prosperous Himalayan village with a major road passing through it. Here, some households purchase wood, but in over 86 per cent of the households, women go out to collect firewood. Even though the forest is nearer the village than it is to Dwing, the average distance to be travelled to collect firewood is 3.1 km, and means a four hour walk. More than half the households make a daily trip to collect wood.

Swaminathan comments on the life of women in these villages: "Leaving their homes at dawn, after nearly an eight-hour day, they return to the village with their load of wood. What is the normal working day all over the world is just the first of the day's tasks for these women. On returning home, the women go about their household work which includes rearing of cattle. And finally they put in a few hours of work on the land." Dwing also has acute water scarcity. In both the villages, three meals are cooked every day. Because of heavy male migration from the area, women are also being forced to put more and more time into agriculture.

**Women trudge eight to ten hours every day from Tapovan village (A) to the top of the mountain (B) to fetch firewood. (Anil Agarwal)**

### Desperate situation

In the dry, arid to semi-arid regions of India, the situation is equally bad. An extreme example is Roli in Sabarkantha district, Gujarat. With scanty rainfall and limited irrigation, the area surrounding the village has become a vast treeless plain. Women here spend four to six hours collecting firewood out of a total working day of 14 to 15 hours. In addition, they trek daily to the well, about one or 2 kilometres away. Firewood is so scarce that even small roadside weeds are collected. Women spend long hours trying to dig out roots of trees cut long ago. Also as the weeds and shrubs do not give continuous heat, they have to be changed often, demanding more of the cook's attention and increasing her misery.

Poor landless women suffer the most. Those who own sufficient land get the fuel from their own lands and the landless and marginal farmers spend a considerable amount of time foraging for fuel and fodder. Even where improved animal husbandry and agriculture have increased the availability of crop residues and dung, it is not necessary that the landless women should benefit.

In Navli, a prosperous village situated close to the Amul dairy in Gujarat, irrigation, cash crop farming and animal husbandry have made several families very rich. But with local firewood supplies dwindling and price of imported firewood rising, farmers with enough cattle have set up biogas plants and have started collecting their crop residues for fuel. So those who have no land face increasing hardships. One poor woman in the village laments: "There isn't enough money for food, so where is the question of buying firewood? We sometimes uproot small plants from around fences. When we are caught we are fined. We have lost our livelihood and it seems, our lives too."

Latest studies show that the problems of women do not end with the collection of fuel. They then face the next Herculean labour: inefficient chulhas which consume too much fuel and belch dangerous smoke. Cowdung is a major substitute for scarce fuelwood and cowdung smoke is reported to pollute more than wood smoke. As Srilata Batliwala sums it up: "A woman in poverty has low access to cooking fuel, spends the longest time obtaining it, and puts it to use in stoves which are not only fuel-inefficient, but also subject her to serious or fatal diseases."
(see Atmosphere chapter)

### Malnutrition

Batliwala also argues that the shortage of cooking energy affects a woman's food intake and that of her family. The scarcity of cooking fuel forces the woman to reduce the energy used for cooking. This may result in fewer hot meals being prepared per day, or increasing the quantity cooked by reducing cooking to once a day or every two days. This not only means nutrient losses, but also a greater risk of infection and illness from eating stale food. Undercooking may also occur when women face cooking fuel shortages, and certain foods can be toxic if undercooked. Absorption of certain food is also affected when they are eaten semi-raw.

Scarcity of cooking fuel can also reduce the time available for cooking and, as a result, the choice of foods. For instance, fuel scarcity can force people to switch over to cereal staples which require less cooking. Thus, more nutritious cereals like bajra, jowar and maize, which are also more fuel-expensive (since they must be baked as rotis) may be given up, in favour of quicker cooking but less wholesome grains like rice. This has been observed in urban areas among slum women who continue to depend on firewood. Rice tends to cook in a shorter time, in a greater quantity and the fire needs less attention.

Despite the concern over cooking energy scarcity little or no research has been done on the nutritional implications. "But the observation of grassroot projects lends credence to the fact that dietary patterns and, thus, nutrition status are considerably affected by the access to, and quality and quantity of cooking energy available to women. Women must perforce limit their time allocation to cooking and fuel gathering since they have a number of other time-constrained tasks and duties which no one else will perform," concludes Batliwala.

## Drinking water

Water carrying is another extremely strenuous activity undertaken by women and it consumes an enormous amount of their time. Available information indicates that women spend long hours and traverse long distances, especially in the hill areas and in the arid and semi-arid parts of the country. In the deltaic plains, the time taken may be less than an hour a day. But this varies: in villages of Karnataka, a study shows this can be from one to 1.4 hours per household a day, whereas in villages of eastern Uttar Pradesh it can be as much as one to 3.9 hours a day on an average.

**Water is fast becoming a scarce commodity in many Indian villages—and expensive too. (Sanjay Acharya/Earthscan)**

Contrary to the popular belief that women enjoy fetching water and washing clothes in a communal place because they can gossip, economist Bina Agarwal points out that the few studies that have bothered to look into this aspect note that, in fact, women usually prefer to wash clothes alone, and seek to avoid time when washing places or wells are overcrowded.

Vina Mazumdar, director of the Centre for Women's Development Studies in New Delhi points out: "Irrigation gets high priority in most plans for rural development, but the supply of water for drinking and washing receives scant attention." M.S. Swaminathan, former Member of the Planning Commission, in his J.P. Naik Memorial Lecture, admitted: If men had to fetch drinking water, then 230,000 villages would not have remained without provision of drinking water after 30 years of planned development." Very few attempts have been made even to combine irrigation and domestic water supply schemes: They are typically conceived of as separate and independent projects.

Bina Agarwal points out that irrigation schemes can in fact have an impact on drinking water supply and, hence, on women as primary carriers of water, even if they are conceived of as separate projects. Seepage from canals can raise the water table and unless this is accompanied by increased salinity, this would replenish drinking water wells and have a beneficial impact. But in several parts of north and central India, the rise in the water table after the construction of irrigation canals has also led to increased salinity in drinking water wells in the vicinity of canals. These wells have to be abandoned leading to severe drinking water problems.

Deep tubewells, on the other hand, can soak up drinking water wells by lowering the water table and increasing work for women who then have to seek alternative and more inaccessible sources. If the drinking water wells of untouchable households fall into disuse, they may be left with no other alternative but to depend on the mercy of the upper caste wells. They obviously cannot purchase their own tubewells. Bina Agarwal gives the examples of Bulandshahr in Uttar Pradesh, where the drying up of village drinking water wells in untouchable communities, associated with the sinking of deep tubewells in the vicinity, has meant that the untouchable women now have to depend entirely on the goodwill of the higher caste to pour out for them the water they need for their everyday use.

Lack of clean drinking water most affects the health of children. But among adults, women are more exposed to hazards of polluted water than men. Firstly, they are the primary carriers of water, and secondly they wash clothes and utensils. Moreover, since childcare is primarily the women's responsibility, when children get infected women are more likely to catch the infection than men. Even if a woman did not fall sick herself, she would have to spend more time caring for the sick. Poorer households will be clearly affected the most, as they have less access to clean water sources and are less likely to have help in domestic chores.

### Extreme conditions

During droughts, the situation can be particularly bad. Women suffer the most. They have to work harder to collect fuel, fodder and water. As food becomes scarce, men migrate to search for work in the towns, but the women are left behind to fend for the children and the old. In a review of the effect of the 1979–80 drought, the journal 'Manushi' pointed out: "As people are forced to live in subhuman conditions, and as human lives are systematically devalued, degraded, it is women who suffer most, are the first to be sold or exchanged for food and the first to die."

In Orissa, a newspaper reported that many girls were sold for anything from Rs 15 to Rs 55 during the 1979–80 drought. Fifty young women went to a magistrate's court in the famine stricken district of Rangpur and registered themselves as prostitutes, which they felt was better than begging.

Millions of women are forced to look for work on relief projects. The little food they get or money they earn benefits them the last, only after the rest of the family has received its share. When Hanna Chamar collapsed and died at a Uttar Pradesh relief project, her husband described her travails in the following words to a reporter: "We get very little grain and we get it very late . . . It was her habit to feed me first, then the children, and not eat enough herself."

In reality, however, the crisis that poor, landless women face in times of drought is only a stark and exaggerated form of the permanent crisis in their lives, which saps their ability to withstand any major perturbation in the environment and this in an area where perturbations like droughts occur with regular frequency. Deforestation and devegetation in general makes nature much harsher and poverty means they can do little about it.

## Fodder and animals

Collecting fodder and caring for animals is yet another major activity of women. But again little information is available on the effect that the general shortage of fodder and the steady destruction of grazing lands is having on the lives of women.

The government has paid little attention to the production of green fodder. Even though the objectives of social forestry include planting of multipurpose trees for the production of both fuel and fodder, the trees that are being planted extensively, like eucalyptus, are deliberately chosen because they are not palatable and cannot be used as fodder.

Promotion of fodder crops on farm lands will only help those who own lands and not the landless and near-landless households who must collect fodder from the immediate environment. Foresters are equally keen to ban grazing in the forests because they see it as a threat to their afforestation efforts. Even where it is not banned, women are regularly harassed by foresters and have to pay heavy bribes or face sexual harrassment. Just as the fuel and water problem is acute in the hills, the fodder problem is equally acute there. Women bent with loads of fodder on their back are a common sight.

Studies conducted in hill villages show that forests and agricultural fields form a combined agro-ecosystem and human beings are crucially dependent on each of its components. Fodder collected from the forests is fed to the animals. The dung, thus, generated is then applied to crop lands to maintain soil fertility. A study of Kumaon villages shows that to support every hectare of cultivated land, about 18 hectares of forest is required to supply fodder and of these at least 5 hectares to 12 hectares have to be well-stocked forests to supply fuel as well. Yet in the entire

### Ordeal for Women

The water shortage that hit Madras city in 1983 will be remembered for a long time. Women's memories will be longest, for it is they who had to bear the brunt, as a report by the Delhi-based women's magazine, 'Manushi', sets out in graphic detail.

The case of Usha, 13, a domestic servant toiling for Rs 20 a month, is a typical one. She worked for the family for her employer as well as her own. She left for work at 6 am and returned at 10 am, worked in her own house, left again for work at 4 pm to return at 6 pm to help her mother with evening chores.

Then began the worst part of her day. Taking as many 'kodams' (vessels) as possible, she spent not less than five to seven hours at the tap collecting water—Metrowater, the city water supply and sewerage organisation, supplied water only on alternate days. If Usha had clothes to wash, she stayed at the tap until five in the morning, returning with five kodams, enough for two days. She left for work again and went to sleep only at 11 pm on the second day for six to seven hours, after a 40–hour stretch of back-breaking work.

The condition of middle class housewives was just as bad. High school student Rajalakshmi, for instance, walked not less than a couple of kilometres every day, spending five hours getting water. Her three brothers, all older than her, were no help, occasionally taking the water from her at the stairs when they had nothing better to do. The ordeal of working women was even worse.

Self-employed families were hard hit by the shortage. Lakshmi's father is a mill worker who, after deductions for a loan, takes home Rs 250 a month. All other members of the family make bidis and agarbattis, labouring from 6 am to 9 pm, with short breaks for meals. Normally, Lakshmi would take 16,000 bidis to her employer and get Rs 25 a day. But collecting water from the bore pump in the colony took up much of her time and as the family stayed awake at night (for water was supplied at night), they could not start work at 6 am as usual. Lack of sleep also meant slower production and the result was that they produced 5,000 bidis less every day, losing Rs 190 a month.

The people of Madras city were fortunate in that water was to be had at their doorstep. The situation in suburban areas up to 20 km away was nightmarish. When the wells the residents depended upon went dry, the better off hired women, who went by train to the city and brought back water at a charge of Rs 15 per kodam per month. Those families who could not afford this service were served, as usual, by their women who walked not less than two hours a day to distant wells. The families washed and bathed on alternate days.

Perhaps the worst hit were the slum dwellers who live just behind the huge buildings that line Marina beach. They depended entirely on water from 7 ft deep holes dug in the beach and the women who inevitably did the collecting now walked 300 metres and back 20 times daily. If Thangamani was too tired in the evening, she came at 3 am the next day to collect 20 kodams every five hours and by 8 am would have walked not less than 4 km. Each time she climbed up to her house on the third floor. If she was too tired she collected only 10 kodams and no one bathed that day.

Only a small minority of men actually carried water. In the middle class areas, men regulated the supply by issuing tokens. They also escorted women to the taps at night. And while women always transported water on foot, men used bicycles and tricycle carts, often as a lucrative business, almost never as a domestic chore.

The heavy back-bending labour could not but affect the health of women. Lakshmi, who ferried water for her family for five months, was bedridden with a collapsed uterus afterwards. She was operated upon but even during convalescence went back to hauling kodams. As she lamented: "I have to, what to do?"

Indian central Himalayas, the ratio of agricultural land to forest land is only 1 : 1.66 and that of agricultural land to good forest is only 1 : 0.26.

In semi-arid and arid areas, poor families keep several species of livestock: cows, buffaloes, sheep and goats. This diversity reduces risk during an adverse climatic period which leads to acute fodder shortage. In many drought-prone areas, households prefer to keep goats as compared to cows. One reason for this is apparently that goats need much less care in a fodder-scarce environment than cattle and this helps to reduce the burden on women for fodder collection.

## Malnourished workers

How does the extraordinarily tough work burden of poor women affect their health? Firstly, studies show that they eat much less than they should, which leaves them extremely malnourished and susceptible to disease. Secondly, repeated child bearing—children are earning members of the family—has a major effect on their health. Thirdly, the work burden is so high that most women do not seek medical care even when they are ill or pregnant.

Batliwala has calculated the amount of energy spent by men and women in their daily chores in Pura village and compared this to their daily food intake. The amount of energy expended by women is about 2,505 calories daily and by men 2,473 calories. But when food intake is compared, men get nearly 800 calories more than their expenditure while women get 100 calories less. This difference in energy intake between men and women has also been found in a study by Leela Gulati of the Centre of Development Studies, Trivandrum, in a typical agricultural labour household in Kerala. On employed days the woman's caloric intake fell short of the recommendations made by the Indian Council of Medical Research by 20 per cent, while the man's fell short only by 11 per cent; on unemployed days the respective shortfalls were 50 per cent for the woman and 26 per cent for the man.

Children are being pressed into service as fetchers of firewood in the grim struggle for survival. (UNICEF)

But Batliwala argues that this apparently small deficit of 100 calories a day amongst village women in Pura must be seen in the light of other realities of village life and of women in particular. Environmental sanitation is so bad and access to clean drinking water so limited, that the vast majority of Indian villagers have worm infestations. These parasites can 'steal' as much as one-fourth of the total food intake.

During pregnancy and lactation, women need an extra 500 calories to 600 calories a day. At any point in time, one third of the women in the country are in this condition, but most of them continue to work without any additional nutrition. The woman is the last to get food in an Indian household.

### Child power

In this constant grind of survival, several studies have pointed out that children begin to acquire an extremely important economic role. They do many crucial tasks like caring for younger children, fetching fuel, fodder and water, and grazing animals, so that the adults can undertake wage labour. In Pura, for instance, children provide 29 per cent of the total time spent on fuelwood gathering, 20 per cent on fetching water and 34 per cent on livestock grazing.

With time, the importance of children cannot but grow. As Amulya Reddy and Srilata Batliwala, who have studied energy consumption patterns in Pura in detail, point out: "Children have become the unwitting victims of the continuing energy hunger in Third World villages . . . a family below the poverty line, which does not have the means either to hire labour or purchase labour-saving devices, is compelled to meet its energy needs only by producing several children."

But this will not only have important implications for the education, health and nutrition of children but also for the country's massive family planning programmes and the health of women. If underfed and overworked women are also expected to bear many children, the impact on their health will obviously be drastic.

### Health hazards

In addition, surveys show that women have less access to health care. The reasons for this are many and deeply related to social and cultural factors like womens traditional shyness in reporting illness and general neglect of female children in a patriarchal society. But the extraordinary work burden on women means that often they do not have enough time to seek health care. Even pregnant women are under such pressure of work that they do not have the time to seek hospitals and doctors. One woman from western Uttar Pradesh explained to a researcher: "Kalawati, my neighbour delivered only a few days ago. She had been working in the fields the whole day. In the evening, she had just finished her cooking when labour pains started and within half an hour the child was born. Only one sweepress assisted the delivery, no nurse, no doctor. Also, she was never immunised. You see, we are already too loaded with family chores. Hospitals, injections, etc, are a time consuming business for us."

A study on health care carried out by the Indian Institute of Management, (IIM) Ahmedabad, confirms that rural health services are little used by women. In the clinics studied by IIM it was found that the sex ratio of patients at a primary health centre was five to one in favour of men. Says Dr Nirmala Murthy who carried out the study: "Women, because of their responsibilities at home, and out of ignorance tend to neglect their illness until they become too sick to move around and attend their normal chores. Often, too, they are dependent on others in the family to get them needed medical attention, which typically has the effect of delaying the health visit. Thus, women do not attend the health clinic when they ought to, and by the time they are sick enough to know that they should attend the clinic, it is much more difficult for them to do so." Under these circumstances, health care for women must be available literally at their doorstep.

Though mortality rates have improved in India, their progress in the case of women has been extremely slow. The heavy work burden, increasing with increasing environmental destruction, together with the lack of health services, must definitely be a major cause for the low health status of women. Maternal mortality is a high 400 per 100,000 births and the average birth weight of poor babies is as low as 2.5 kg, leading to high infant mortality.

The heavy and unending work burden of women involved in collecting fuel and fodder has implications even for promotion of family planning strategies, especially those based on tubectomy. Joyce Pettigrew recently found in a village in Punjab that many women want contraception. As tubectomy is the family planning mode promoted by government agencies, many have undergone the operation. But almost all of them — nine out of the ten interviewed — had post-operative pain. The women wanted to take rest, but this was impossible because of their daily work load. Women in agricultural labour households were in a particularly bad situation. Collecting fodder for the

## Woman Power

Khirakot is a small village in Almora district nestling in the Uttar Pradesh Himalayas. As in all hill villages, its women work in the fields and fetch fuel and fodder for their homes, from the surrounding panchayati forests. The forests had dwindled from tree to scrub to roots and the women, to breathe new life into the vegetation, fenced them off and restricted grass cutting in the protected patch. They even planned to plant trees on their own, the next monsoon.

Meanwhile, a Kanpur contractor obtained a lease for soapstone mining in these hills. Local men were employed in the mine. Slowly, the contractor's activities expanded and he even set up a unit to grind the soapstone near the main road.

This was when the women realised that something had to be done. For one, mine debris cluttered their carefully preserved patch of forest. "The forest we were nurturing was now only stone," said one. Secondly, the narrow bridle paths to the reserve forests were overrun by mules ferrying soapstone from the mine to the factory and every day the women had to wait hours for the lines of mules to pass before they could get to the forests. And when the rains came, the dust from the mines swept down into the fields, forming into a thick crust on the soil which the women found impossible to plough.

Attempts by the men to reason with the contractor failed. The men stopped working in the mines and built walls to prevent the mules from using the paths but were daunted when the contractor filed a criminal case. But the women had decided, "Either the mines will remain or us." They collected money from each household and sent the men to fight in court. The case was to drag on for two years and cost the village Rs 5,000.

Meanwhile, the women resorted to direct action, physically stopping work. Said one: "We would catch hold of the workers' implements and not let them dig". We asked them to kill us first, to bury us in this mountain, before they could touch the hill, said another. A third put it simply: "Their mining was destroying our lives, our children's future. How could we let them mine?"

The contractor countered with hired thugs who terrorised the villagers for days. Said one woman: "They stoned our houses. We were scared to go out at night, because the contractor's men would prowl around the village." Another recounted: "One man even showed us a revolver." Kuntidevi's son's cloth shop was burned down and she recalls: "Only we know how fear-filled and difficult those days were for us."

Sometimes their resolve was shaken by doubt—"the contractor said the government had asked him to mine in this area, how can the government be wrong?"; by fear of authority—"people said the contractor held Delhi in the palm of his hand"; but ultimately their resolve prevailed, even over the money the man from Kanpur offered them. His last bait was ownership of the mines but the women were unshakable: "We want our forests, the fodder and our fields."

**These women warriors of Khirakot have got mining leases cancelled. (Kamal Joshi)**

Whenever the contractor tried to revive production by hiring Nepali labourers or women from other villages, the Khirakot women would disrupt work. The district magistrate, who visited the village was taken around the area and shown the destruction the mines had wrought and, moved, he recommended that the lease be cancelled.

Finally, in late 1982, the mines were officially closed. The women of Khirakot settled down to the damage: they filled in the ditches, built a protective wall to prevent the debris from destroying their fields and planted oak trees in the panchayat forests. But their biggest reward is similar movements emerging in other parts of the region, in Pithoragarh and in Jhiroli, sparked off by the flame of protest lit at Khirakot.

buffaloes would take as much as three hours and one woman while pregnant was walking four miles daily for fodder. Fodder had to be collected from landlord's fields from between the wheat plants, and as this was frequently forbidden by the landlords, a lot of time had to be spent in searching for fodder. Firewood collection required a separate journey.

**Time spent by women on household activities in different parts of India (hours/days)**

| | hours/day |
|---|---|
| Fetching water | |
| Eastern UP | 1.0–3.9 |
| Western UP (pregnant women) | 0.8–3.0 |
| Karnataka | 1.0–1.4 |
| Fuelwood gathering | |
| Himalayan | 4.0–7.2 |
| Karnataka | 0.4–0.9 |
| Fetching water & fuelwood gathering | |
| Gujarat-Rajasthan border | 6.0–9.0 |
| Grazing animals | |
| Western UP (pregnant women) | 0–3.0 |
| Karnataka | 0.5–1.0 |
| Making dung cakes | |
| Western UP (pregnant women) | 0–0.5 |

Source: Various studies

All this work involved bending and stretching which aggravated the post-operation pain. In such a situation, women were unable to cope with house and field work and they tried to pass it on to others, especially their children. Pettigrew found that in many cases this increased family tensions enormously. One woman from an agricultural labour household kicked and punched her 13 year old daughter, fatally, complaining that the child was playing, not working. In another household, the woman began to send her son for fodder after the operation and her husband had to hire a woman at ten rupees a month to make dung cakes. Pointing out to another woman in the village, her artisan husband complained: "she also had an operation and she is doing much more work than you."

Pettigrew, therefore, concludes that as women, especially from agricultural labour households, cannot avoid strenuous work, medical interventions like tubectomy can only lead to family conflict and tragedy and must be avoided.

## Women and male migration

Male migration, a common phenomenon in large parts of rural India, is an important factor affecting the work burden of women. A number of factors have led to increased migration in search of job opportunities: population growth, increased pressure on land, and a technological transformation in agriculture itself that has promoted landlessness.

Introduction of irrigation and high yielding varieties in specific parts of the country have created regional imbalances in agricultural development. Migration of agricultural labour from Bihar and eastern Uttar Pradesh to Punjab now takes place on an extensive scale. Similarly, in fishing villages in Kanyakumari district men have begun to migrate more and more. Kanyakumari has become a labour catchment area for mechanised fishing in Kerala and eastern Tamil Nadu. Fishermen from Kanyakumari now spend anything between two to seven months of the year on mechanised boats in Cochin, Trivandrum and Tirunelveli districts, sometimes going as far as Orissa and Karnataka.

The destruction of forests and grazing lands has put extreme pressure on tribal and nomadic people, forcing them into landlessness and migration in search of jobs. For instance, tribals are migrating in large numbers from Dhenkanal district of Orissa to cities like Cuttack, Bhubaneshwar and places like the Assam tea gardens.

Very little research has been done on the effects of this migration on the women left behind. Most studies of rural-urban migration have emphasised the positive economic benefits which accrue to the village because of remittances by the emigrants. But Andrea Menefee Singh of ILO points out that the life of women left behind in the village can be hard. "If the oral tradition is any indication (folk songs, for instance), the emotional price the women pay for their husbands' emigration is very high," says Singh.

Divorce rates are high among emigrants, which means that the proportion of women deserted after emigration may be fairly high. Surveys in Bombay slums have also shown that men who have migrated without their families have a high incidence of venereal disease, which probably means that they are transmitting these diseases to their wives on home visits.

### Added burdens

An important issue which needs to be looked into is the extent to which male migration leads to an increase in women-headed households. Among the lower castes, where nuclear families predominate even in the village, marked increase in women-headed households would seem to be a distinct possibility. But it is also possible that males would be reluctant to migrate alone unless they are able to leave their families under the guardianship of close kin.

Households where women are the sole adult income earners are already quite numerous: about 18.7 per cent of households in India, according to one estimate. Female-headed households are generally poorer than male-headed households. According to M.S. Swaminathan, women are the sole or chief breadwinners in 25 per cent of poverty-stricken families. Many women who come forward for food-for-work programmes are from such households and studies indicate that their number is increasing.

The migration of men means that women, especially in female-headed households, spend more time on agriculture. In Haryana, the agricultural work load of women increased after men took up jobs in cities. This work is in addition to domestic chores like fetching fuel, fodder and water.

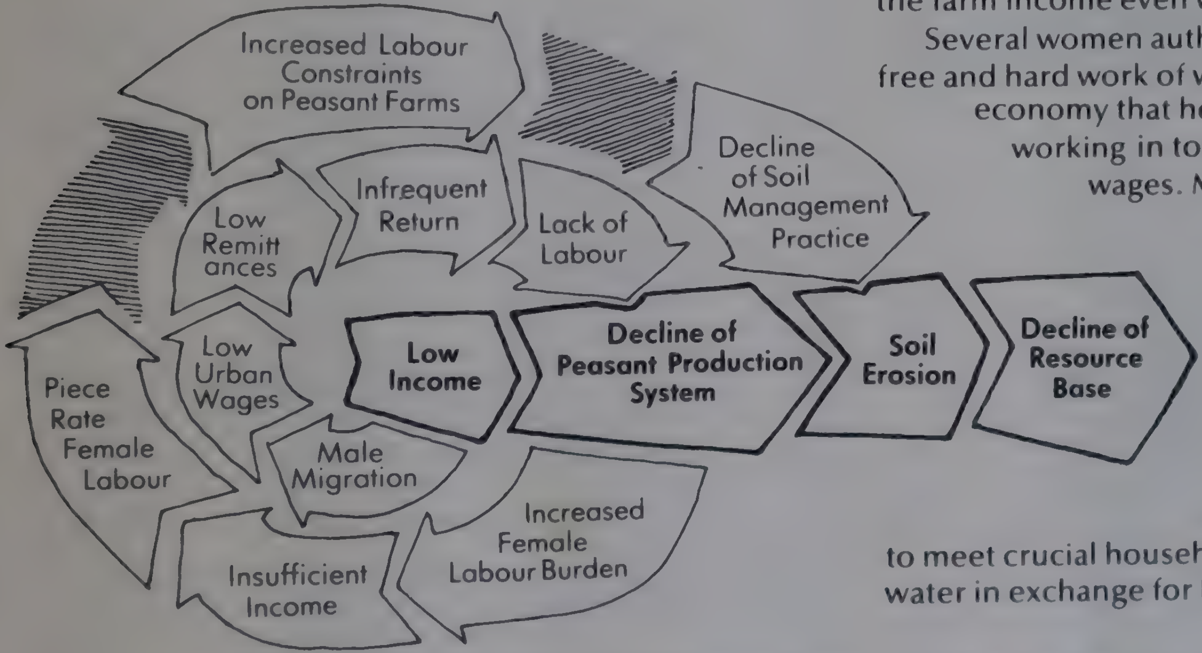
A study of three villages in the Kumaon region of Uttar Pradesh, shows that women have to put in an extraordinary amount of time in the fields in addition to fetching fuel and fodder. In these villages male migration is also high. The survey showed that 0.9 persons per household had migrated. Sometimes the incidence was as high as 2.33 persons in households with five persons each. Consequently, the male: female ratio in the villages was

1:1.4 for the working age group 15-50 years. During the peak agricultural season the women worked as long as seven hours at cultivation and animal husbandry. The amount of energy expended as human labour for fuel and fodder collection averaged 2.5 times the amount of human energy spent on cultivation in these villages.

The Kumaon study notes that with receding forest cover, energy expended in direct agricultural activity as compared to energy expended in fodder and fuel collection will decrease every year as women will have to go further and further to gather wood and forage. And this will lead to a shortage of labour for cultivation.

### Overworked women

The future spells disaster both for the environment and for the people in these villages, especially the women left behind. Because of the small landholdings—the majority of which average 0.5 hectares—farmers cannot grow forage crops in their fields. As firewood grows scarce or too difficult to collect, increasing amounts of dung—traditionally used as manure—will be burned as fuel, and because of the lack of manure the productivity of the land will decline further. The final consequences will be a highly degraded physical environment and an increasingly undernourished, overworked population, especially of females, unable to eke out a decent living.



This schematic diagram was prepared by Professor Phil O'Keefe of the Beijer Institute, Sweden, to show how male migration in Kenya sets off a process leading to a decline in the soil resources base. It is probably true for several parts of India as well, especially the Himalayas.

A study from Ratnagiri district in Maharashtra shows that land may actually be unutilised because of the heavy male migration from that area and the inability of women to cope. According to Rajani Desai, who has conducted a study for ILO, Ratnagiri represents the district with highest incidence of emigration in Maharashtra, mainly to Bombay. As a result, the initial pattern of migration of men, without the woman and family, has persisted.

This has resulted in a majority of women in the population of Ratnagiri district. The 1981 census shows that there are 1,242 females against 1,000 males in the district against an average sex ratio of 938 for the entire state. Says Desai: "... the women do many of the men's jobs in the villages, or they learn to manage without the fruits of such labour. Thus, land must somehow be tilled or allowed to lie fallow. The cultivable waste is as high as 21 per cent of the total land under cultivation (according to the agricultural census, 1970-71), whereas it was 3.7 per cent for Maharashtra as a whole ... we found with interview after interview, land cultivation was having to be less intensive (than before and than desired), or even abandoned, because manpower (more accurately, female power—editor) in families was inadequate."

### Deceptive incomes

But don't earnings of male migrants help women to meet their household needs more easily? It is unlikely that migrants' remittances help to buy fuel, fodder and water because there is no real (or extremely limited) market for the supply of these commodities in villages. Secondly, many poor migrants' wages are so low that they are not able to send any remittances back home. Thirdly, women have little control over their husband's earnings or for that matter, even their own. The study from Haryana which showed that women's farm labour had increased when men took up jobs in the city, also reported that men usually returned at harvest time to sell the crops, thus maintaining control over the farm income even when they were working outside.

Several women authors have argued that it is in fact the free and hard work of women in sustaining the domestic economy that helps to keep a large number of men working in towns and cities at extremely low wages. Many male workers can hardly support themselves on a permanent basis. As a result, they keep a part of their families back in the village. The woman ekes out a subsistence living by working on her small farm or, increasingly, on others' farms as a wage labourer. Plentiful nature, as long as it remains so, helps to meet crucial household needs like fuel, fodder and water in exchange for labour.

When women go out to seek work for themselves, they get paid even less than the men. But this extraordinary double exploitation of women, where she suffers not only her own exploitation but also of her husband's, will become unbearable when the bounties of nature disappear. The input of labour needed to collect the traditionally, non-commercial commodities can clearly increase only to a point in a woman's limited day.

The scarcity of erstwhile non-commercial goods is in fact already beginning to commercialise them and new forms of exploitation are emerging. In certain recently prosperous areas of Haryana now, farmers do not give away cotton stalks—widely used as fuel—free to agricultural labourers. The new rule is: pick an acre of cotton and take the cotton stalks. Many women undertake this labour to get the family's supply of fuel. Earlier they would not only get the crop residues but also some wages.

### Hard labour

Low incomes of husbands and growth in landlessness means that many women themselves have to look for work outside their own farms. Many are even prepared to migrate. Large numbers of women seek casual employment during slack seasons in irrigation, road and other public works. The number enrolled under the Maharashtra Employment Guarantee Scheme is reported to be larger than that of men. Thousands of tobacco farm workers in Andhra Pradesh are seasonal family emigrants, including females and children. Female rural migrant labour also plays an important role in sugarcane harvesting in Maharashtra and Gujarat, paddy cultivation in Punjab and Haryana, and in plantation labour in the Northeast and south India.

To earn some cash for the family, several million women, especially amongst tribal families, are taking to cutting wood illegally and selling it in the towns. These women, known as headloaders (see next section), are forced to do this because even the limited earnings of the men seldom come back to the family. Many tribal women, who had traditionally learnt to live in harmony with their environment, are today keen to get as much resources from the forests because they are afraid that if they don't get them first, the forest officials will sell them off to the contractors.

In the absence of alternative jobs, many poor women are forced to take up headloading as the only source of sustenance, despite extremely low earnings and extremely hard labour. Law Jamko, a Ho tribal woman from Singhbhum, told 'Manushi' about a tribal woman from Gua, who was deserted by her lover after she gave birth to a girl. The woman has no land and so she has taken to selling wood from the forest to feed herself and her child. The income is so low that she still can't get enough food.

### Crucial earnings

Among the landless or near-landless households, surveys show that women's earnings are often crucial for survival.

### Minefields

When mines are dug in a backward tribal area, their affect on women is the worst. Since nationalisation, women miners are paid the same wages as men. But this has led to a tremendous decline in women employed, and has exposed them to increased sexual harassment.

Mines are based on the destruction of local tribal agriculture. Since adivasi women are more involved in farm work than men, the growth of mines has a more devastating effect on them. Wherever rehabilitation is considered whether by giving employment to the displaced, by settling them on land elsewhere, or by paying them compensation, women are never even mentioned. Even if a woman's land is being snatched away, if she does not have a male heir she cannot be employed in the mines because further recruitment of women, even for overground work, has been stopped. Plots of land are given, according to uncodified Hindu law, only to men.

When displacement takes place in tribal areas in this eastern part of India, men usually migrate in search of employment to Calcutta, Jamshedpur or Patna, while women try to survive on forest produce or work in large number on roads and dam construction sites. In Ranchi and Santhal Pargana districts, teams of tribal women set out in search of work, each with usually one man to cook and take care of the possessions. These teams usually engage in loading work at the mines. Among harijans and backward castes, men usually migrate to cities while women stay home with the children, singlehandedly managing agricultural work for nine months in the year. Men come home in the monsoon to do the ploughing.

The laws made for "protection" of women in the industrial sector have turned out to be most detrimental to their interest. For instance, they are forbidden to work underground in mines, or to work in the evening and night shifts even overground. Also, there are provisions of equal work, maternity leave, rest shelters, creches and so on. In the nationalised mines, therefore, the management has not only stopped recruiting women but has also begun to retrench them with a vengeance. The provision of special facilities also serves as an excuse for profiteering mine owners to stop employing women. Usually, in privately owned mines where the management ignores these laws, women are employed in larger numbers than men, because they are paid lower wages, and are thus used to increase profits.

Women in coal mines face the particular problem of invisible retrenchment. Middle class non tribals became interested in coal mining jobs after higher wages and job security were introduced. The administration, in collusion with some trade unions, has launched a voluntary retirement scheme, first floated in 1976, according to which any woman below 57 can voluntarily retire and nominate her son, husband, brother-in-law, son-in-law or any other male relative to take over her job: the man will get the advantages of her seniority. The scheme has resulted in large scale buying of jobs from women by middle class non tribal men, for a couple of thousand rupees.

Very little of this money actually reaches the woman, because administrative officers, union leaders, contractors, and often even the woman's husband or sons all claim a share. The non tribal usurpers sometimes produce false marriage certificates or affidavits stating that they are the husband or the son-in-law of the woman. Sometimes, such a man actually marries a tribal woman, but deserts her as soon as he gets her job, or as soon as she gets pregnant. Hence the strange phenomenon in coal mine records whereby a Jha, Misra, Upadhyaya, Singh, Sahu or Mehto is the son or son-in-law of a Manjhi, Munda, Oraon, Bhuiyan, or, if the woman is a Bilaspuri, of a Satnami or Ravidas.

It is common for a woman's husband, son or father to claim her wage straight from the employer. He may then spend it on liquor or gambling. Even in nationalised mines, a woman's wage is handed to her husband. However, adivasi women usually collect their own wages, because they work separately from men in women's work teams and there are fewer social restrictions on them.

In privately owned mines, there are no rest shelters for women and children, and even in nationalised mines, the shelters are not worth the name. Neither are there any bathrooms or toilets for women. Infants have to be left in the care of children or have to be left sleeping on a stone slab.

Adivasi women from Chotanagpur and Santhal Pargana areas are taken by contractors to brick kilns around Patna, working 12 hours a day for extremely low wages. Women of this area are even found in the Assam tea gardens. These women are sexually exploited and victims of superstition and custom. A childless woman or a widow or one who was once a widow is in danger of being declared a witch by other villagers. She may suddenly be blamed for a mishap in the village, and punished physically and financially. Sometimes she is beaten to death.

Another evil practice spreading in the industrial areas, particularly in the mines, is that of men staking women during gambling. One such incident took place in a gambling bout between the workers of Jharkhand colliery and those of Laiyon colliery. The Laiyon colliery workers won a woman worker from the Jharkhand colliery and carried her off. In another case, a man from Kedla colliery gambled away his wife. When she refused to go with the winner, her husband cut off her nose.

A study in six villages — two each in Kerala, Tamil Nadu and West Bengal—found that in households with no land, where both women and men were earners, the average of women's contribution to household earnings was more than the men's in five villages and equal to the men's in the sixth. Among marginal landowning households too, female earnings from outside work ranged from a little under half to well over half of the total household income from outside employment. Further, on average, the minimum contribution by the women was higher than the minimum contribution by the men, in almost all the villages in both classes of households.

Though women often have little control even over their own earnings, studies show that when they do have some discretion they tend to spend the money on family needs, rather than on themselves alone, whereas men, tend to spend a good deal of what they earn on their personal needs such as liquor and cigarettes. This is a common source of conflict in poor families.

The psychological effects of an urban-centred, cash oriented development process, which generates this male migration, are probably the worst. In an area like the Garhwal Himalayas heavily influenced by male migration, even the men staying back or those who have returned from the towns do not show any interest in improving matters at home. In many villages of Garhwal, there is enough land, which if afforested and cared for, could provide an enormous part of the total household needs and substantially reduce the daily drudgery of women. But the men have little interest in the local ecosystem and in making it more productive. Unless work can generate cash, it is of no interest to them. It is not surprising that the women show much greater interest in afforestation programmes that can meet household needs like fuel and fodder.

### Increasing presence

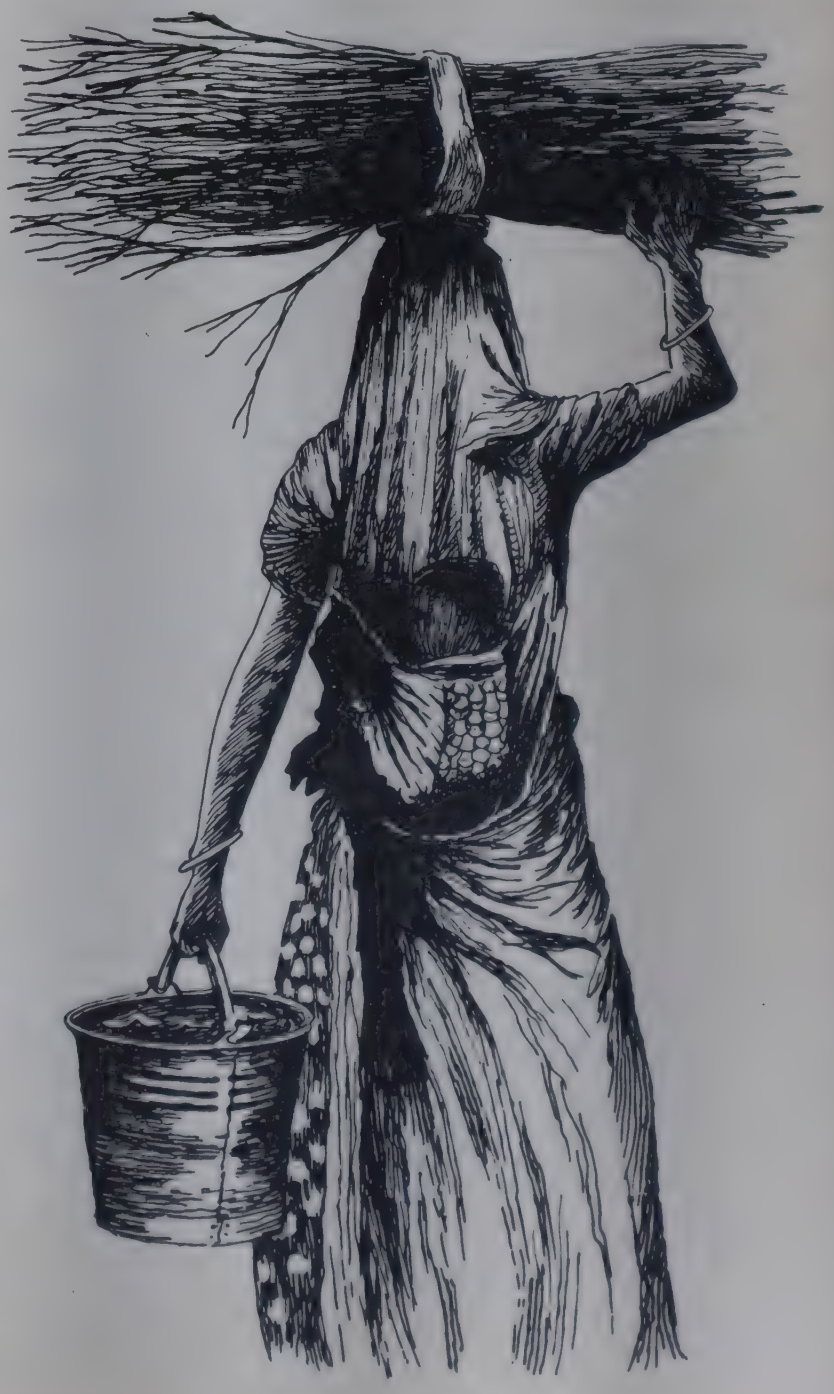
For those interested in rehabilitation of ecologically sensitive areas, this extraordinary work burden of women will have to be carefully taken into account. Bina Agarwal believes that census data on female work participation may be reflecting the real level of women's involvement in non-domestic work in the hills than in the plains, where for reasons of culture and status and of biases within the census definition of work, female work participation rates may be underestimated. The 1981 census shows that the proportion of women in the workforce is high in most mountainous areas. In the Northeastern states, it varies from 41 per cent Nagaland to 32 per cent in Mizoram. In Uttar Pradesh female work participation rates in the five hill districts of Uttarkashi, Chamoli, Tehri, Pithoragarh and Garhwal are the highest in the state and range from 49 per cent to 32 per cent as against the state average of 6 per cent. Of all women workers in the state, 46 per cent are classified as cultivators. But in these five hill districts, 96 per cent to 98 per cent female workers are cultivators who do everything on the farm except ploughing. In all these areas, collecting fuel, fodder and water also takes an enormous amount of time.

In such a situation will women have the time for the heavy labour required for soil and water conservation practices in the hills? Fortunately, the experience of Chipko workers, for instance, shows that women have a great interest in restoring the ecosystem especially to meet household needs more easily and bring the agricultural systems to a more sustainable basis.

Unfortunately, the status of women makes it difficult for them to get organised or for social workers to get them organised. But there is growing evidence that women in the hills, where ecological destruction is at its worst and the work burden the highest, are responding eagerly to social and ecological issues like tree planting and prohibition.

## Technology introduction

With the growing awareness of energy and environment problems, several efforts have been made in recent years by the government to promote new technologies like biogas plants, fuelwood plantations, fuel-conserving smokeless chulhas, latrines and handpumps. These can reduce the rigours of rural living, improve health and meet fundamental household needs. Srilata Batliwala has calculated that if cooking fuel and water were readily available close to the household in Pura villages and the efficiency of stoves was improved to reduce fuelwood consumption, a saving of nearly 500 calories per day per woman could be affected. Yet success stories about the



## Ecodevelopment With Women

Vyamru is a picturesque Himalayan village perched at a height of 6,000 feet in the mountains of Uttarakhand. Tibet is only 50 km away. It was here, in February 1984, that students and social workers got together with 50-odd villagers for two days to undertake community tree planting work, in an ecodevelopment camp organised by the Dasohli Gram Swaraj Mandal (DGSM), the Gopeshwar-based organisation at the forefront of the famous Chipko movement.

DGSM regularly organises such camps to take ecological development to the people. They began in 1975, but their character then was of in-house brainstorming sessions where DGSM workers, local students and activists would get together to plant trees. The villagers stayed away. Explains Chandi Prasad Bhatt, a DGSM founder and Chipko leader: "Even though we could organise protest movements, we still felt hesitant in approaching the communities for constructive work. We did not know how they would react, especially the women."

Then there was a landslide near Pakhi village, where DGSM workers had already started afforestation work. This brought the ecological crisis home to the villagers and in turn, close to DGSM. The local people started taking interest and simultaneously the survival rate of the trees began to crawl upwards from a dismal 10 per cent. Slowly contacts with other villages also grew. The villagers began to discuss other problems of health, roads and the absence of various other services.

From Pakhi, the afforestation work expanded to Dwing and then to Vyamru. Today, DGSM is working in 27 villages of the Patalganga, Birahiganga and Dudhganga catchments. In 1982-83, the government gave it some financial support for ecodevelopment camps. In 1982 and 1983, it organised some 20 such camps. "Now our work is mainly concentrated on creating conditions in which the villagers can plant trees themselves," explains Bhatt.

The camps are as much an education for the workers as the villagers. When the first camp was organised in Vyamru the residents, insisted that their biggest problem was not fuel and fodder—the nearest reserve forest is just half an hour away—but protecting their crops from wild animals like pigs and bears. DGSM workers suggested building a wall around the fields and planting trees only in the protected space between the wall and the fields. The community agreed and the DGSM workers learnt their first lesson: find out the villagers list of priorities rather than imposing your own and help them with it.

This year Vyamru women harvested a hundred headloads of grass from the protected area. Six such protected patches now exist in the village where thousands of fruit, fuel and fodder species have been planted, protected by walls. "But these have to be people's walls", insists Bhatt. The people must feel it is their wall, there to protect their interests, and not to keep them away from their rights.

Survival rates of Vyamru plantations are as high as 90 per cent to 95 per cent. A cursory survey did not reveal even one dead seedling whereas in a nearby forest department plantation undertaken presumably on contract, of 60 seedlings, 59 were dead. Significantly, tree planting and tree care is almost entirely undertaken by women.

The ecological awareness of women was evident at the Vyamru camp. Several women came from distant villages, many without their husbands. On the first morning, to the beating of drums and other local musical instruments, the women assembled with their basketloads of manure to apply them to a patch of trees planted earlier. Next morning, they and the camp's other participants assembled again to plant trees on the steep side of a mountain. Few men turned up, even though Vyamru is one of those few villages in the district where most men still work at home and have not migrated to the plains.

After the back breaking community exercise the women trudged off to the forest to collect fuel and fodder. In the afternoon, they attended discussions on environment and development. Subhda Devi, wife of a retired soldier, and head of Vyamru's Mahila Mangal Dal was elected the chairperson of the meeting. Uninhibited, she openly scolded the men in the village who prevented their women from taking up tree planting work. The head of Mahila Mangal Dal of village Kimana was unhappy that Bhatt and his co-workers had not been to their village for several months. This was only one of a battery of requests from women to hold similar camps in other villages soon.

Local men appear to have become the victims of a development process that has completely destroyed the earlier culture of self reliance and has bred, particularly in the men, increasing psychological dependence on the government for all personal and community needs. Local afforestation can substantially improve the lot of the people and alleviate the increasing drudgery of women's lives. But the men, unfortunately, are not prepared to do much to improve the village economy. At best, they will "turn four tumblers upside down" and set up a tea stall, as Radha Bhatt, social worker from Almora put it.

Men now expect the outside economy and its investments to do everything: build hospitals, schools, roads and give them jobs, even if it is only as a low-paid babu. Most of the cash earned goes into buying terylene shirts, transistor radios, alcohol and tobacco. The women labour to fulfil daily family needs like fuel and fodder.

When asked: "Why don't the men do things in the village which they themselves could do?", most of them appeared surprised at the question. The first response was: "times have changed." But with persistent questioning, one of them argued: "But we are ignorant people. We are not educated. How can we think for ourselves?" But educated people are the first to leave the villages.

Moreover, education does not help them understand the potential of their environment. There are enormous water and land resources in these villages with which they can generate sufficient energy and produce several times more fodder, food, honey, fruits, animal products, clean drinking water, building materials, medicinal herbs, and various raw materials for local crafts. Unfortunately, scientists and engineers have not done anything to teach people to improve their local economy and environment with available natural resources, and to increase local self reliance.

A discussion at the camp on this subject was revealing. Almost all the men wanted their villages connected to good, motorable roads. Many came from very remote villages, which they had to reach climbing mountains "like monkeys", as they put it. Roads would help them sell their goods at remunerative prices. A citrus farmer pointed out: "Today the buyer in the market town forces me to make a distress sale when I bring my fruits. He knows I must sell at whatever price I get, because I can't take the fruit back to my village. These buyers will themselves go to the villages connected by roads and negotiate the price with the farmers." Thus, for men, roads are to connect them to the dependence-creating, urban-based, market economy of the country.

Roads do make many vital services accessible. Women in remote villages want roads because they face the danger of fatal complications at the time of childbirth. Maternal deaths during childbirth are frequent in the region. But even good footpaths and mule tracks would be very useful. Before 1960, there were 374 km of footpaths and 113 km of motorable roads in the Chamoli district. But between 1960 and 1983, the Public Works Department (PWD) Directorate General of Border Roads and other government agencies built a total of 609 km of motorable roads and only 75 km of footpaths. When Bhatt asked a PWD official why they couldn't build footpaths connecting every village instead of only a few motorable roads, the surprised official said: "But you must be the first person who has told me so in years. Every politician only wants a motorable road."

The women, as opposed to the men, are much more sensible. At the end of the meeting, a woman from Kimana quietly told a DGSM worker: "Look, we don't want any road. Just please tell Bhattji to come to our village and help us plant trees and save our fields. This is the only 'vikas' (development) we want."

Thus the social situation in Uttarakhand is extremely depressing and encouraging at the same time. The social, economic and cultural crisis affecting the men is the dark side of the picture. But the women's response to the challenge posed by ecological destruction and their desire to participate in other social issues like anti-liquor campaigns is extremely encouraging. The unprecedented decision of a village woman to stand for panchayat elections in the village of Bached, even though her husband was not very happy about it and all kind of rumours were spread against her, is also an indication of the change taking place. She lost but still obtained 64 votes.

**Near Gopeshwar, a dense oak forest has been preserved, thanks to the vigilance of Chipko women, who patrol the area every day. (Sunita Narain)**

Bhatt's workers do everything to ensure that women participate in their camps. In most villages where DGSM is working, Mahila Mangal Dals have been formed. Bhatt ensures that women preside over meetings organised during the ecodevelopment camps.

These dals have in some cases even begun to assert their control over the newly created community resources. In one village, the women fought the village sarpanch over the distribution of the grass from their afforested patch. A woman from the sarpanch's family carried away grass that had not been authorised by the Mahila Mangal Dal. Usually the dal announces a day when one person from each household can come and take grass as a simple way to ensure equitable distribution. The village women protested strongly against the sarpanch, who in turn had a case filed against them. But the district magistrate had to withdraw the case when faced with a combined protest from all the women, which, as one observer put it, is an excellent case of an informal people's organisation asserting its right to control community resources, which it has created, even over a legal institution like the panchayat.

Efforts are also made by DGSM to organise other members of the community. The youth, for instance are made members of an informal organisation, started by the students of Garhwal University at Srinagar, called Dalyon Ka Dagadya (in Garhwali, Friends of Trees).

But the gulf between men and women is still quite dramatically large. This can be seen at village Tapovan, situated right in front of the former Belakuchi bridge, washed away during the massive 1970 Alaknanda flood. The village lies at the bottom of a kilometre-high mountain. The only remaining forest is right at the peak and women go up there every day to fetch fuel and fodder and bring back heavy loads down the steep path.

There are hundreds of hectares of wasteland around the village, including a massive cactus patch. The men complain about the state of the rickety bridge built by the government after the first one was washed away and the road was given a new alignment. "Please, sir, tell the government to make a new bridge. Our women have to walk across this bridge with heavy loads every day," an elderly, well educated, retired army person lamented. But the job of nailing down three wooden planks across the bridge to cover the holes gaping down into the frightening Alakananda was left to the young co-workers of Bhatt. The village has not thought of clearing up the cactus patch and planting trees either.

The women, however, had an urgent message. "Please tell Bhattji to come to this village soon. Tell him we are even prepared to make the walls ourselves. We want to plant trees." They knew that their men would do little to help. "They will only come for the fruits when the trees grow up," the women said. Every woman in the village also wanted a smokeless, fuel-saving stove for her household.

DGSM is also promoting new energy technologies: biogas plants and smokeless stoves. The villagers of Tirosi, who live hemmed in between the river and a cliff, with only a small forest around, gladly carried dozens of bags of cement and bricks for a community biogas plant. Every household in Dwing now has a smokeless stove. In Vyamru, too, the meeting ended in a demand for smokeless stoves from several households.

Elsewhere in Uttarakhand, women are beginning to demand smokeless stoves, says K.S. Kunjwal, an old Sarvodaya worker from Almora who attended the Vyamru meeting. Kunjwal first built a smokeless chulha for his mother in the early 1950s. "We built a few of them in the villages of Almora then, but because of lack of interest, we soon gave up the work. Now suddenly there is new awakening. People are even paying us money to come and build these stoves," he says. Kunjwal is training people in the hills to make improved stoves.

Women are attracted not just to the fuel savings but also to the lack of smoke. Bhatt explained to the Vyamru women how smoke not just affects the eyes but also causes cancer. His own close relative, a priest at the temple of Badrinath, who had never smoked nor lived in towns died a year ago of lung cancer. There was no ostensible reason for the disease, except that as a conscientious priest, he would regularly supervise the cooking for the Badrinath pilgrims in an heavily smoke-ridden environment. Latest research shows that wood smoke contains substances known to be carcinogenic.

Yesterday, it was a quiet desire to participate in tree planting. Today, it is a demand for better stoves. Tomorrow, the women will ask for more say in community decisions. Women will not only confront their men in their bid to organise themselves, but will also ultimately have to confront the value system being spread by the all-pervasive, dependence-creating, new culture from outside. Local leadership like the DGSM can play a crucial role in this revolution.

In the evening, the women in the Vyamru camp sang an old Garhwali song: "Do not go away, my love. If you stay back, we will soar in the sky like the legendary birds." Never was the desire for living and working together with men to build a better life so poignantly expressed.

spread of these technologies remain few and far between.

A major reason for this failure is that these dissemination programmes seldom involve women either when the technologies are being developed or when they are being disseminated. Any technology that supplies cooking energy should obviously be directed towards women. For example, a community biogas plant was set up in Fateh Singh ka Purwa, a village in Etawah district of Uttar Pradesh, the first such plant to serve an entire village. Every household, rich and poor received gas from it.

Technologically this demonstration plant was a success but socially it was a failure. It ran well for a year but soon the community started losing interest. Most of its members stopped providing cowdung and the plant more or less came to a halt. Male community leaders pointed out they were not interested in energy for cooking. They would rather have energy to power irrigation pumps, chaff cutters and milling machines.

A report by Nirlep Malhans and Jyoti Sanghera in 'Manushi' points out that women were extremely critical of the plant. It was decided, without consulting them, that gas supply would be limited to two hours in the morning, from 8 am to 10 am. By then, the women were already in the fields. Clearly, the plant's organisers had completely ignored their work on the farm. The women also complained that the gas did not even provide 25 per cent of the day's cooking, and they now had to look for wood as a substitute for dung cakes. Further, the new technology also increased the women's dependence on men: they had to depend on men even for routine cleaning of the burners.

After the Fateh Singh ka Purwa plant, the government has established several dozen community biogas plants as demonstration projects in various parts of the country. But not one is under the control of women. Because of the failure of community biogas plants to involve the 'community', there are now several proposals to use biogas energy to develop small/cottage industries, in order to improve their economic viability. In an energy-starved environment, if questions of economic viability, are raised women's cooking energy needs will probabaly be relegated to second place.

## Women ignored

There are a number of other technologies like solar cookers, fuelwood plantations and smokeless chulhas which could either help to increase the supply of cooking energy or help to conserve it, and would thus be of great interest to women. But again, in hardly any of the official programmes

### The New Agriculture

Very few women own land themselves but they play an extremely important role in agriculture. They may even have been the inventors of agriculture. Temple murals in northeastern India inhabited by tribal communities, for instance, portray women as the first domesticators of plants. Women's traditional tasks in agriculture are transplanting, sowing, weeding, harvesting, winnowing and threshing. In shifting cultivation, the men chop down trees and burn the green cover; planting and gathering of crops is done mainly by women. The massive socio-economic and technological change that is taking place in Indian agriculture is having a major impact on women. With male migration increasing, even the taboo on women ploughing appears to be lifting, as in Himachal Pradesh, because there simply aren't enough men to go around. Eighty per cent women workers work in the fields as compared to 64 per cent of the men.

A disturbing trend among female agricultural workers is that more and more are becoming agricultural labourers. Between 1951 and 1981, the number of women engaged as cultivators dropped from 18.4 million to 15.2 million and the number of agricultural labourers went up from 12.7 million to 20.95 million. The reasons are many: population growth leading to fragmentation of holdings; indebtedness leading to loss of land; and eviction of tenant farmers by landlords.

Economist Bina Agarwal argues that the implications of the Green Revolution technology—high yielding seeds and irrigation—for women are complex and not necessarily positive. Rural women are usually employed as casual and family labour, hardly ever as permanent labour. In Andhra Pradesh, Tamil Nadu and Orissa female casual labour accounts for 90 per cent of the total female labour on the farms. By contrast, men are employed as casual, family and permanent labour.

She argues that the adoption of high yielding varieties (HYV) rice in these three states had led to a rise in total labour time per hectare. This increase is largely accounted for by female and male causal labour. The impact on female family labour is, however, complex and varied. On the one hand, the adoption of HYVs increases the demand for family labour on the farm. On the other hand, as family income rises with HYVs women tend to withdraw from manual labour in the fields because of family prestige considerations. The final impact is the combined result of these two diverse tendencies. Hence, HYVs have led to a decrease in the use of family labour in Andhra Pradesh, an increase in its use in Tamil Nadu and a neutral effect in Orissa. Also, the size of the farm is an important factor: women belonging to large farm households do not usually do manual work in the fields due to social status reasons.

For women of agricultural labour household, the HYV rice technology may have been advantageous in terms of an increase in their employment opportunities. However, inflation has cut down daily real wage earnings. In some states, daily real wage earnings have actually declined. This is likely to adversely affect women's nutrition more than men's because of the unequal distribution of food in favour of male members in rural households. Also, women of poor rural household bear the double burden of fieldwork and domestic chores.

**Women Engaged in Agriculture, 1951-1981**

| Year | Cultivators | | Agriculture Labourers | |
|---|---|---|---|---|
| | No. of workers (million) | % of total female workers | No. of workers (millions) | % of total female workers |
| 1951 | 18.4 | 45.42 | 12.7 | 31.37 |
| 1961 | 31.9 | 55.32 | 14.2 | 24.61 |
| 1971 | 9.2 | 29.73 | 15.8 | 50.99 |
| 1981 | 15.2 | 33.03 | 20.95 | 45.57 |

Source: Report of the Committee on the Status of Women in India and Census of India, 1981

For women of those those farm households where an increase in crop production and income has led to a withdrawal of women from the field, the fieldwork burden has decreased. However, in many such cases the domestic work burden has increased as for instance, in Punjab where in many landed ouseholds women now have to cook meals for the labour ired to work on the farm. Agarwal says: "It is noteworthy that in the heart of the Green Revolution, namely, Punjab, while there have been considerable improvements in the technology handled by men, in the form of tractors, threshers, combines aimed at promoting these systems, have efforts been made to involve them. In those few programmes, mainly by voluntary agencies, where women have been involved, the success rate has been high.

In almost none of the social forestry projects launched with aid from international organisations like the World Bank—with the sole exception of the USAID-assisted project in Madhya Pradesh—has any effort been made to involve women and virtually all these schemes have ended up as schemes for farming trees as a cash crop. In Chamoli, where the Chipko Andolan has been organising ecodevelopment camps and women have been involved, they have clearly opted for fuel and fodder trees. Similar conflicts in male-female interests over 'cash trees' and 'household trees' have been noticed in the Thar desert, in East Africa (Kenya) and in West Africa, indicating that these contradictions are a cross-cultural phenomenon.

Pandurang Hegde of the Appiko movement in Karnataka reports that women are taking a keen interest in it. In Kerehosahalli village of Uttar Kanara district,the local mahila mandal took direct action to prevent tree felling even though the men had refused to take any interest. In about 25 villages, women set aside a handful of grain every day as a contribution to the Appiko movement. At the end of the month, the grain is collected and is used for camps and for those who keep watch in the forests to prevent tree-felling.

The successful experience of architect Madhu Sarin in promoting smokeless chulhas also shows that involvement of women is crucial in disseminating such a technology. Several attempts were made in the past to promote smokeless stoves but most ended in failure. None of them had made a special effort to involve women. Even decisions to spend small sums of money on smokeless chulhas, for instance, or small amounts of extra work on improved house ventilation, have to be taken by the men in the household, and they may not show any interest.

Few attempts have been made by official agencies to involve women in drinking water supply and sanitation programmes, even though many such programmes have been repeated failures. Thousands of handpumps have been installed in villages and the majority are usually out of order at any point in time. But few programmes have made special efforts to train women to repair these pumps.

### Narrow views

It is often not just ignorance but literally distrust of women's abilities to cope with new technology that leads to their neglect in official programmes. The simple technology of

Jack Ling/FAO

etc , there has been little improvement in the women's kitchen apparatus, even in the economically well-off households."

With the Green Revolution technology there have also been changes in the agrarian structure. For example, many land owners have now evicted their tenants and resumed land for self-cultivation, pushing such small and marginal cultivators into the ranks of agricultural labourers. Women in such households now have to seek work in the fields of other. Also, with increased concentration of land it is likely that much more widespread mechanisation will follow in the wake of HYV adoption. If operations such as threshing, harvesting, and transplanting are mechanised, it will affect female labour much more adversely than male labour since women are confined primarily to these operations; and if this happens any noted employment advantage to female casual labour with HYV adoption is likely to be negated.

New agricultural technologies can hurt women in many other ways. Weedicides, for instance, can reduce the demand for women labour dramatically, as they are heavily involved in weeding operations.

Another major effect of irrigation is the change that it induces in cropping patterns: the land earlier devoted to subsistence farming gets diverted to production for the market and additional income may not necessarily mean more food for the family.

According to Govind Kelkar, who has studied the effects of Green Revolution in three villages of Etawah district, the new agricultural technology is 'anti-participatory' as far as women are concerned. Says Kelkar: "Technological development programmes, by creating a demand for cash to purchase pumpsets, HYV seeds, fertilisers, pesticides etc have of necessity led to the formation of collective bodies like cooperative societies. These bodies, unfortunately, apart from being totally dominated by the rural elite, have failed to involve any women."

Kelkar further points out: "With the cultivation of cash crops entirely for the market, women have no decision-making power regarding the requirement of grain at home. Economic principles are paramount when such decisions are made (by men). Women with no control over expenditure or marketing lose authority at home. This has been the natural consequence of displacement from the spheres of work and market."

Women seldom learn about improved farm methods, technological skills, cooperatives and livestock activities from extension workers. Credit facilities are less easily available to them. Loans are often given against land titles, which are usually held in the men's names, or credits are extended through cooperative societies, of which mainly men are members.

Women's participation in agriculture is being affected even in many areas where the Green Revolution is yet to reach. The committee on the Status of Women in India pointed out that in tribal areas, where women have participated in agriculture in large numbers, the shift from shifting cultivation to terraced cultivation is leading to gradual displacement of women from their traditional position in the community. Even in the matrilineal community of the Garos in Meghalaya, the development of orchards and terraced cultivation has started the process of cutting down on women's activities. Government agricultural extension workers teach new methods only to men.

Collecting fodder is often more time-consuming and back-breaking than gathering firewood. There are simply no Sundays or holidays when it comes to fetching fuel, fodder or drinking water. (Mark Edwards/Earthscan) oral rehydration, for instance, holds out the hope of dramatically reducing diarrhoea deaths amongst children—about 6 million children die every year in the Third World and as much as 1.5 million pre-school children in India—which is often called a permanent epidemic. The technique is simple: take certain fixed quantities of salt and sugar and mix it with a glass of water and make your child drink it every time it has a stool. But disseminating this technique would mean informing women in every household, especially poor households where diarrhoea deaths take place.

But the Indian government and the WHO find this too difficult. To rationalise, it is even argued that it is difficult for rural women to measure accurately—as if women don't measure salt and sugar while cooking every day. Official agencies have taken the easy way out by setting up factories in which oral rehydration salts are put into packets and sold or made available at primary health centres. This strategy ensures that poor households will never benefit from this revolutionary technique, and diarrhoea deaths will continue by the millions.

Yet another case of neglect of women in technology introduction exercises is provided by sanitation programmes. The 1980s is the International Drinking Water Supply and Sanitation Decade and by 1990 every government must provide clean drinking water and adequate sanitation to all according to a UN resolution. Whereas governments continue to put up a facade formulating drinking water for all programmes, this is not even being attempted by most governments, including India, in the case of sanitation programmes. The official explanation given for the neglect of sanitation programmes is that they require changes in deep-rooted behavioural factors, which bureaucracies cannot bring about. Rural people are said to be ignorant of the health implications of toilets.

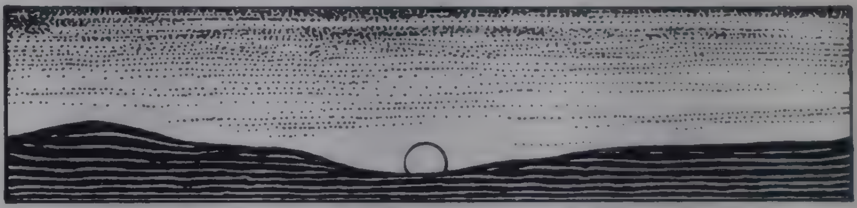
### Private needs

The sociological literature on sanitation behaviour is amazingly small, but whatever exists does show that sanitation programmes are accepted much more by women than men because of their greater need for privacy. In Bangladesh, scientists reported at a conference on diarrhoeal diseases that rural men eased themselves according "to their natural requirements" but women only before sunrise or after sunset. In rural households, "when women felt the need for defecation during daytime they had to hold it with difficulty until sunset. Sometimes such women escaped lunch so that they could hold the bowel motion for a longer time. This escaping of lunch occurred several times in a month, in the case of most women. On occasions when they failed to hold the motion, they defecated hastily in the backyard." The situation in India should be no different.

Groves can be important for women's privacy in rural areas. "I learnt about the feminist aspect of sanitation." remarks a middle class woman from Delhi, "when I went out to a village in eastern Uttar Pradesh. There were no toilet facilities in the village, the land was dry and parched for miles around; and, no tree to hide behind. Like the village women, I too had no choice but to hold my urge until dusk."

Just above Gopeshwar, the district headquarters of Chamoli, there is a dense oak forest but all around it now, is barren treeless land. As the town grew rapidly during the 1960s, the forest surrounding it disappeared to meet the fuel and timber needs of the town's residents. A small oak forest still remains only because women from Gopeshwar village take turns every day to keep strict watch over the forest and prevent even fellow village women from taking any grass or wood, except according to a schedule fixed by the women themselves. The women explain that the forest is not only the last remaining source of fuel and fodder for them, but it is also the only place left where they can go for ablutions without inhibitions.

Voluntary groups working in the slums of Bombay also find that women are particularly anxious to get toilets. They defecate after sunset and have to look around for isolated spots: just the places that leave them open to rape and molestation.



## Clear conclusions

It is clear from available reports that the economic and ecological changes taking place in the rural areas are generally having an adverse impact on women. Women, given their role in the household, are being left to deal with the biomass-based subsistence economy to sustain the daily survival of the household, even as the growth and the penetration of the cash economy destroys the ecology and pulls the men into its fold, both physically and psychologically, deepening the gulf between male and female interests.

Tired, overworked, undernourished, unrepresented, powerless and unorganised, that is the fate of poor Indian women today, and the future, unless the present is drastically altered, promises only more of the same. Landless and near-landless women with limited access to sources of biomass are of course in the worst position. Landlessness and marginal holdings meanwhile increase across the country with the destruction of forests and grazing lands, agricultural modernisation and population growth. Yet the government is only planning to make things worse by proposing legislation like the Forest Bill. Any legislation which prevents access to remaining sources of biomass will be anti-poor women in particular as it will open up opportunities for their increased harassment and exploitation, sexual or otherwise.

The 'carrying capacity' of poor women in India has probably reached its physical limits. But their keenness to participate in Chipko and Appiko and in other tree-planning exercises, is probably, the first sign of a widely-shared and growing militancy amongst poor women to protect and enrich the natural resources that sustain them. But clearly before these straws in the wind — disparate, isolated efforts — can come together to become a powerful movement for change, there is still a long way to go. Meanwhile, the degrading environment can only make women's lives more difficult.

# HEADLOADERS

It is a usual sight these days to see hundreds of weary women with heavy bundles of wood by their side at the Ranchi railway station early in the morning. For these women, mostly tribals, this is just a part of a gruelling two-day cycle of work.

Increasing numbers of tribals and other poor are taking to unauthorised cutting and selling of firewood. Although the work is hard and the money earned a pittance, it is an important source of income for these poor people.

The Xavier Institute of Social Studies has published a striking report on headloaders in Ranchi by T. Bhaduri and V. Surin. A study of 170 households spread across nine villages, it shows that headloading has emerged as an important profession only over the last 15 to 18 years.

More than a fifth of the households list headloading as their major occupation; in some villages as high as 40 per cent. For nearly 20 per cent of all the employed people in the villages, unauthorised cutting and selling of wood has become the primary occupation. Working as day labourers in farms and forests was secondary, and cultivating their own land came third. For another 50 per cent of the employed headloading is the second occupation and farming the first.

**A two day cycle**

The Ranchi firewood sellers, mainly tribal women, usually begin their day at 2 am because they must complete household chores before setting out on the 8 km to 10 km walk to the surrounding forests to collect wood. Seven or eight years ago, the forests were just a kilometre or two away.

The wood is sold in the nearest town: Ranchi. To reach the market early, the women must leave their villages the previous evening by train or bus and spend the night at the railway station or some other public place. Each woman can carry at best a 20 kg headload, which sells for Rs 5.50 to Rs 6.50. About a third of this money is lost in bribes to the forest guards and the train conductors. With the remaining money they buy essentials like rice, edible oil, kerosene (for lighting) and salt.

Work begins again as soon as they return because they must cook dinner, probably the only freshly cooked meal of the day. The next morning they usually take leftovers from the night before for lunch when they set off once again to collect wood. The back-breaking work of cutting and selling wood apart, poor nutrition undermines their health further. Women fainting at the Ranchi station is not an uncommon sight.

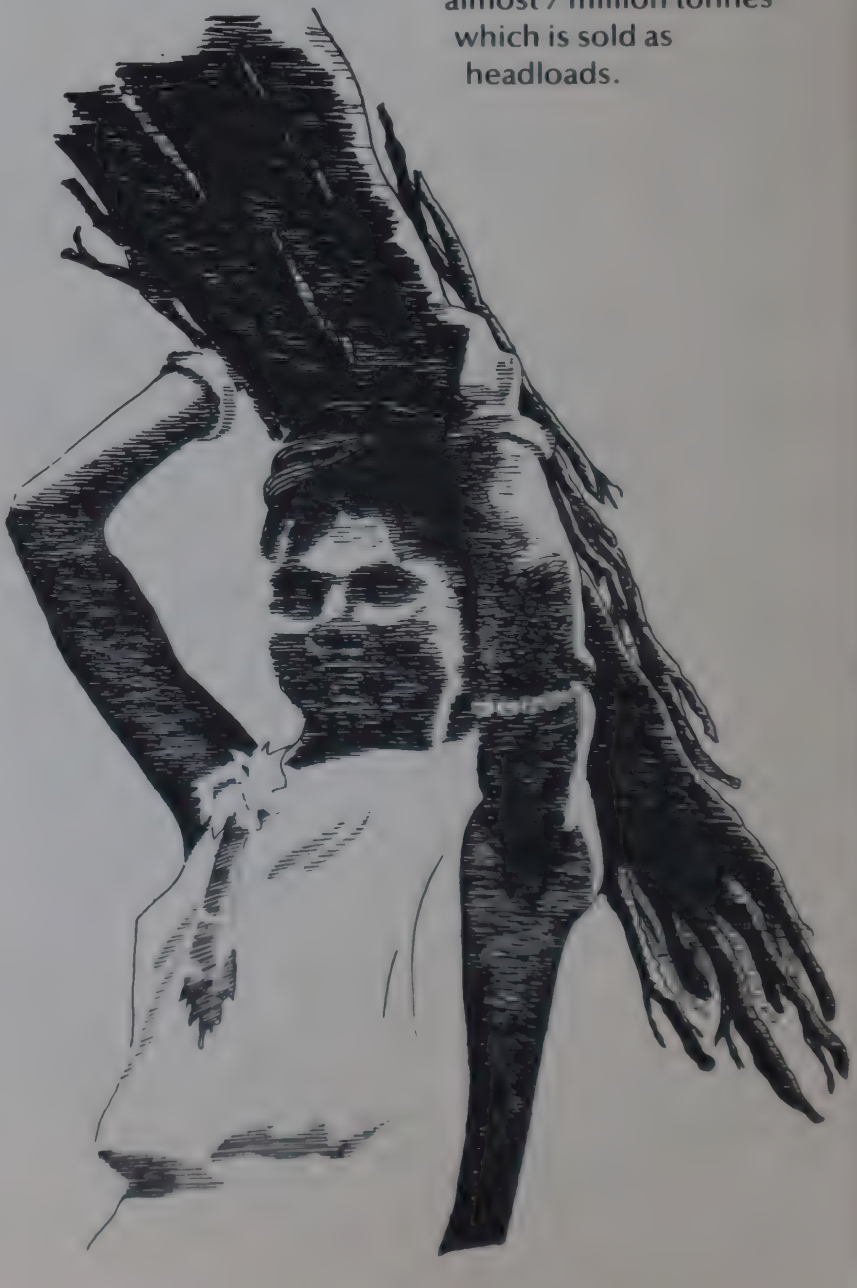
Extensive deforestation, and restrictions on shifting cultivation and sale of minor forest produce has hit the tribals hard. In Ranchi, most headloading families have little land; what they have is either upland or wasteland which is uneconomical when cultivated. Many of these people took to headloading in 1979-80 when the monsoon failed.

It is ironic that the tribals, who for centuries lived in harmony with forests, are today forced to eke out a living by further destroying their forests. But the Ranchi women headloaders say that even if they used the forest properly, the forest contractor in collusion with forest officials would cut it down indiscriminately. So they would rather grab what they can before this happens.

The headloaders find a ready market for their wood in towns and cities because of the inadequate supplies of commercial fuels like kerosene and LPG. A report from Palamau in Bihar says that tribal women often collect two or three headloads a day from the forests and sell them at Rs 1.50 to Rs 2.00 to households and tea shops. Many also work for wood contractors. The wood finally makes its way to markets in Varanasi.

An exact estimate of the total number of headloaders in the country does not exist. The 1981 census covered them under the group "harvesters and gatherers of forest produce" and "log fellers and wood cutters" but the data has yet to be tabulated. The 1971 census estimated all forestry workers (which included headloaders) at about 200,000 but experts say that this is nowhere near the actual number. For instance, the Madhya Pradesh government has estimated the number of headloaders in Jagdalpur, the headquarter of Bastar district, to be 100 but when a researcher recently asked the villagers about this, they laughed and said that just two or three villages would have that many headloaders.

It is possible that at least 2 million to 3 million people are headloading today, making headloading India's biggest source of employment in the energy sector. Even if 50 per cent of the estimated 14 million tonnes of firewood purchased annually in urban India is supplied through the organised firewood trade supervised by the forest department, that leaves almost 7 million tonnes which is sold as headloads.



if each person sold three headloads of 25 kg each, collecting and selling firewood would provide an occupation for 2 million to 3 million people. The actual number is probably higher because, besides those who do this work through the year, there are many who headload only when no other work is available.

In conditions of acute poverty, headloading is often the only occupation available. In Palamau district of Bihar, for instance, where the incidence of bonded labour is very high, bonded labourers often take to headloading because this is the only activity that can earn them some cash: the wages they get are only a handful of grains. Rehabilitated bonded labourers have also taken to headloading because they find it the only occupation available.

A major attraction of headloading, even though it is one of the lowest paid occupations, is that unlike other jobs like construction work or harvesting, it provides employment throughout the year, except during the monsoon. In their paper on employment opportunities for women in forestry, Malini Chand and Rekha Bezboruah of the Institute of Social Studies, New Delhi, show that firewood collecting paid only 20 paise per hour. They had studied 64 firewood collecting households in Betul district, Madhya Pradesh.

### Mainly Women

Studies show that large numbers of headloaders are women. In Ranchi district, for instance, the majority of the headloaders are women in the 25-40 age group. Tribal tradition credits women with better marketing sense and bargaining capacity compared to men as they are prepared to wait hours for a good price while men prefer quick deals. Also an independent profession like headloading ensures women control over the income earned which otherwise would be spent by men on liquor and tobacco. The income from headloading, thus, plays an important part in the nutrition and basic needs of these families. Besides, women are paid less than men in other jobs such as construction work.

Collecting firewood is hazardous for headloaders and often means negotiating rough terrain. A team of researchers of the Self Employed Women's Association (SEWA) undertook a study in Girnar forests in Junagadh, Gujarat, and discovered that as many as 58 per cent of the women are hurt by their axes while cutting wood. These poor people are provided with no medical facilities and any illness is a liability for them. In most headloading areas the women are malnourished. One of the Junagadh headloaders, Puribai Kasambhai says, "We have to go very far to collect firewood. We can eat only when we are able to sell firewood. If the monkeys pinch our bread, we have to go hungry."

Headloaders' children are often neglected. Sometimes when there are no elder brothers and sisters or grandparents, they are left totally uncared for, even when ill. In Junagadh 89 per cent of the headloaders had nuclear families. The literacy rate for women was also extremely low in the area—only about 5 per cent. It was found that 99 per cent of the girls did not study and 83 per cent of the children helped in collecting firewood. Sometimes the children cook for themselves in the afternoons if their mothers are away and there are no leftovers from the previous day.

Although men do help women collect firewood it is usually only when they are incapable of doing any other work. The few men who pick firewood in the villages near Ranchi are mostly above 40 or below 15. A meticulous socio-economic analysis of the village of Birbans in Singhbhum district of Bihar has been conducted by O.A. Mascarenhas and Bhagwandas Manipur of the Xavier Labour Relations Institute, Jamshedpur. Birbans is 29 km from Tatanagar on the Saraikela road from Jamshedpur and has a population of 531 people. The study probes the income distribution profile of the headloading community of Birbans and is of particular interest because the village is a heavy fuelwood user (see box).

Studies and reports from various southern states like Andhra Pradesh, Kerala and Tamil Nadu tell a similar story. A report on social forestry in Tamil Nadu prepared by the Tamil Nadu Agricultural University, Coimbatore, reported that landless agricultural labour resorted to firewood trade only when farm employment was not available. Of the 18 villages, spread over nine districts, selected for the study, fuel collection and sale either as a regular business and or intermittently was practised by over 50 households in seven villages.

Like the villagers in the Bihar study, these fuelwood collectors operate in groups of four and five but prefer to collect and sell individually. The average weight of a headload was estimated at 14 kg which sold for Rs 5 or 7, that is, Rs 350 to Rs 500 per tonne. In the Nalur area of Dharmapuri district, the estimated annual firewood gathered amounted to 103 tonnes by 15 households with a total of 22 members. Each household earned on average between Rs 2,400 and Rs 3,500 annually from firewood sales, considerably more than the Bihar tribals.

Most headloaders operate under the pretence that they are collecting wood for their own use. Forest authorities complain that this regular group activity is responsible for much deforestation. "Earlier, women used to come with sickles, now they come with small axes," laments one official. Forest officials in the Girnar forests complain that 10 times more wood is drained out from Girnar in the name of firewood than in any other place in the country. There has also been a sharp increase in green felling: women cut down some green branches, and wait for a few days for them to dry so that they can take it away as only dead and dry twigs can be removed.

To deter headloaders, a toll system has been introduced in some states. The Girnar forests are surrounded by several toll stations; headloaders have to pay a toll of 10 paise for every headload. In places where forests are guarded and felling is illegal, headloaders have to bribe forest guards and range officials. Interviews with headloaders in Birbans revealed that Re one per headload and Rs 2 per shoulderload was the normal bribe. In Ranchi headloaders have to pay regular bribes of 10 paise to 25 paise to railway staff and police constables. In some villages in this area the "Koutilya" tax system is in vogue: headloaders pay about Rs 2.50 to a village head per week so that they can collect wood without any problems. Headloaders might end up losing up to 20 per cent of their income in bribes.

Headloaders are often punished severely if caught pilfering wood from protected forests. In the Girnar forests, people caught cutting any of the reserved species of trees have to forfeit their axes to the toll station authorities. The Madhya Pradesh government is planning to ban headloading in all towns with a population of more than

S. Paul/Chitrabani

50,000. Headloaders claim they are penalised often because of their inability to bribe officials the way other vested interests, who cart away truck loads of timber, are able to

### The real scourge

Headloaders are now labelled "the scourge of our forests". K.P. Sagreiya, a former chief conservator of forests, complains that in Madhya Pradesh, where he worked for 30 years, permission was given for people to remove as much wood as they could by headloads as long as it was "dead and lying" in the forests. "Now that such wood has long been picked up, live trees are being girdled, killed and removed in headloads with impunity. Such removals alone far exceed the total growth of the forests which are getting progressively depleted. It is time these malpractices are stopped," he says.

Madhya Pradesh forest officials are considering Sagreiya's suggestion that forest departments cut wood themselves and auction it to headloaders. Forest officials argue that they cut trees in a scientific manner in accordance with silvicultural rules, but experience shows that corruption often prevents this from happening. Moreover, if forest departments get involved in supplying headloaders, the firewood trade will become an organised racket benefiting only large contractors. Headloaders will then be completely at the mercy of forest officials.

The worst thing about headloading is that there is no real policy about it in most states. In Tamil Nadu, for instance, where there is apparently a policy but it is not known to lower level forest officials or to the headloaders themselves. Lower level forest officials thus invent their own policies and implement them according to their whims.

### Some solutions

Various solutions have been suggested. For instance, cooperatives of tribals and the forest department could be set up to lessen the mistrust. But forest cooperatives are sophisticated institutions. Fr Michael V.D. Bogaert of the Xavier Institute of Social Studies points out: "Such cooperatives might serve as a facade for vested interests, which they were expected to replace. This has happened in the past."

### Birbans — A Case Study

Once covered by thick bamboo growth and trees like mahua, sal and bamboo, Birbans village is now quite bare except for the few acacias planted by the social forestry programme of the Tata Steel Rural Development Society. The villagers say that trees were felled by timber merchants who had bought them from the local block development officer 15 years ago.

The degraded land has subsequently been put to the plough but the soil has lost much of its nutrient reserves because of extensive erosion over the last two decades. Although the land is well inundated by the Charinadi river, grain yields are poor. Most farmers get no more than 400 kg of paddy per acre and grow only one crop a year. They thus raise supplementary income from forest resources.

Firewood is the major fuel. Others fuels are cowdung, limited quantities of crop residues from the single annual crop, dry leaves from nearby acacia and eucalyptus plantations and, occasionally, pilfered coal from the goods train that slows down between Kandra and Sini. Total energy consumption in the village is equal to about 728 tonnes of firewood, of which about 26 per cent is used for cooking, about 45 per cent for pot and tile baking and the rest in community dinners organised during marriages and births and 20–odd festivals, and for funerals.

The few trees left in Birbans are not used for fuel purposes. Almost all fuelwood comes from nearby forests, the nearest being 7 km away. It takes villagers between eight and 10 hour to collect fuelwood and bring it home. Birbans villagers feel they have a right to the neighbouring forests and in any case they cannot afford to buy fuelwood, even though the village is above the poverty line.

Many villagers are also involved in pottery and tile manufacture because fuelwood is freely available, as many as 47 of the 108 households. Together with the six landed households who own about 30 per cent of village's cultivated land, these kumhars (potters) dominate the other castes and regulate wood collection.

Fuelwood collection is a group activity. The groups which are formed with no cultural, religious, ethnic, caste or class barriers and, out of a total adult population of 333, some 50 go to the forest every day leaving at 6 am and returning by 4 pm. Women carry from 25 kg to 40 kg per headload and men about 50 kg to 60 kg. Usually, some collectors leave very early in the morning, collect the wood and carry it about a third of the way back home after which they are relieved by a second batch of collectors. During days when fuelwood consumption peaks, the same group of people carry the wood all the way back. Some five households bring back cartloads, with each cart loading 400 kg.

The Birbans villagers collect an estimated 882 tonnes of wood each year. As their domestic consumption is only 656 tonnes, they have a marketable surplus of about 226 tonnes, which they can sell at the rate of Rs 300 per tonne in the nearby weekly markets. Hence each household probably earns as much as Rs 635 every year from the sale of wood.

The villagers collect about a tonne of wood in the form of poles, each household earning another Rs 360 every year. Firewood and timber sales together bring about Rs 995 per household to Birbans, or over 40 per cent of its annual non-farm income. These sales bring in over 40 per cent of the total income in the landless households.

The village tile and pottery industry would not survive if free flow of fuelwood was restricted because apparently the pots and tiles are being sold for a price lower than what direct sales of fuelwood would fetch.

Headloading is now playing a crucial role not just in meeting basic cooking energy needs for Birbans village but also in generating a substantial amount of the cash income in the village, and maintaining its village industry.

**Headloaders, most of them women, come to Ranchi railway station every day to sell firewood. (Ranjan Ghoshal)**

Another solution is to legalise headloading by issuing permits against a token payment for specific forest areas specially developed for fuelwood. The headloaders could also be encouraged and helped to grow quick growing fuelwood trees on denuded forest land with the assurance that the fuelwood in these areas would belong to them.

Forest departments could engage headloaders on a daily wage basis to collect fuelwood and deposit it in a forest godown at a nominal price or on a commission basis to sell at market rates. Forests inhabited by tribals could be delinked from the forest department and alternative structures could be set up to help tribals to safeguard, develop and exploit their forests. Rather than headloaders buying wood from the depots controlled by the forest department, it could be the other way around and tribals could afforest deforested lands and control the produce of forests.

There have also been suggestions to provide headloaders with alternative employment. Schemes have been undertaken in Junagadh by SEWA to train women in making wooden handicrafts like cots and planks. Persuaded by SEWA, 300 women gave up headloading in 1982. The forest department provides them with wood at subsidised rates and has made arrangements to buy the products.

Another group of women found work in forest department nurseries. But these nurseries were recently discontinued because of the withdrawal of funds from the National Rural Employment Programme. These women, again unemployed, went back to headloading or became housemaids.

SEWA in Junagadh has organised the women headloaders into a union and has set up a day care centre for their children. In addition they have started a garment-making centre using a grant from the state government. This grant also provides for a leadership and competence building programme for women. In early 1984, SEWA organised a meeting of women headloaders of Girnar forests to acquaint them with government schemes. Ela Bhatt of SEWA is keen to see these headloaders undertake tree plantations themselves.

The Gujarat forest department has a scheme under which land and seedlings can be provided to landless families. These families will be paid a monthly salary by the department for their labour in planting and tending trees. One-fifth of the proceeds from the sale of timber, when the trees are harvested, will also go to the landless families.

SEWA volunteers feel that getting headloaders, especially women, to undertake their own plantations would be an excellent opportunity for improving their economic status. But most of the women at the meeting simply said that they wanted jobs. An overwhelming majority of them wanted jobs in government nurseries and tree plantation programmes. SEWA believes that in time to come the women will have the confidence to undertake afforestation.

Women's cooperatives in other areas like Dehra Dun and Tehri Garhwal in Uttar Pradesh have successfully stopped green felling: mahila mandals snatched axes and sickles from woodcutters. To lighten headloaders' drudgery, the Doon Ghati Shikshan Sansthan in Tehri Garhwal distributes mules to mahila mandals. The animal are hired out for Rs 5.

Headloading is not an easy job. The work bends backs to the limit and the returns do not seem to be commensurate with the immense amounts of labour that go into it. It is a measure of the poverty in the countryside that millions of poor women have taken it up as a major means of keeping body and soul together. The efforts of a few voluntary organisations to ease the burden are commendable but much, much more needs to be done.

# HEALTH

*For the past 40 years, nearly 10,000 chemicals have been synthesized, worldwide, every year We know nothing about the toxicity of 80 per cent of the chemicals in use.*

*India's chemical industry, with 4000 factories, is the most dangerous one in the country. In 1980, 10,000 workers were injured in accidents and 100 killed, 33 for every 100,000 employed.*

*India uses nearly 100,000 tonnes of pesticides annually. At least 70 per cent of this tonnage is contributed to by pesticides banned or severely restricted in Western nations.*

*A WHO study, which analysed food samples across India, found that 50 per cent were contaminated with pesticide residues, with 30 per cent exceeding permissible limits.*

*Over 2500 died in the world's chemical industry disaster, when gas released from a pesticide factory painted Bhopal red in December 1984.*

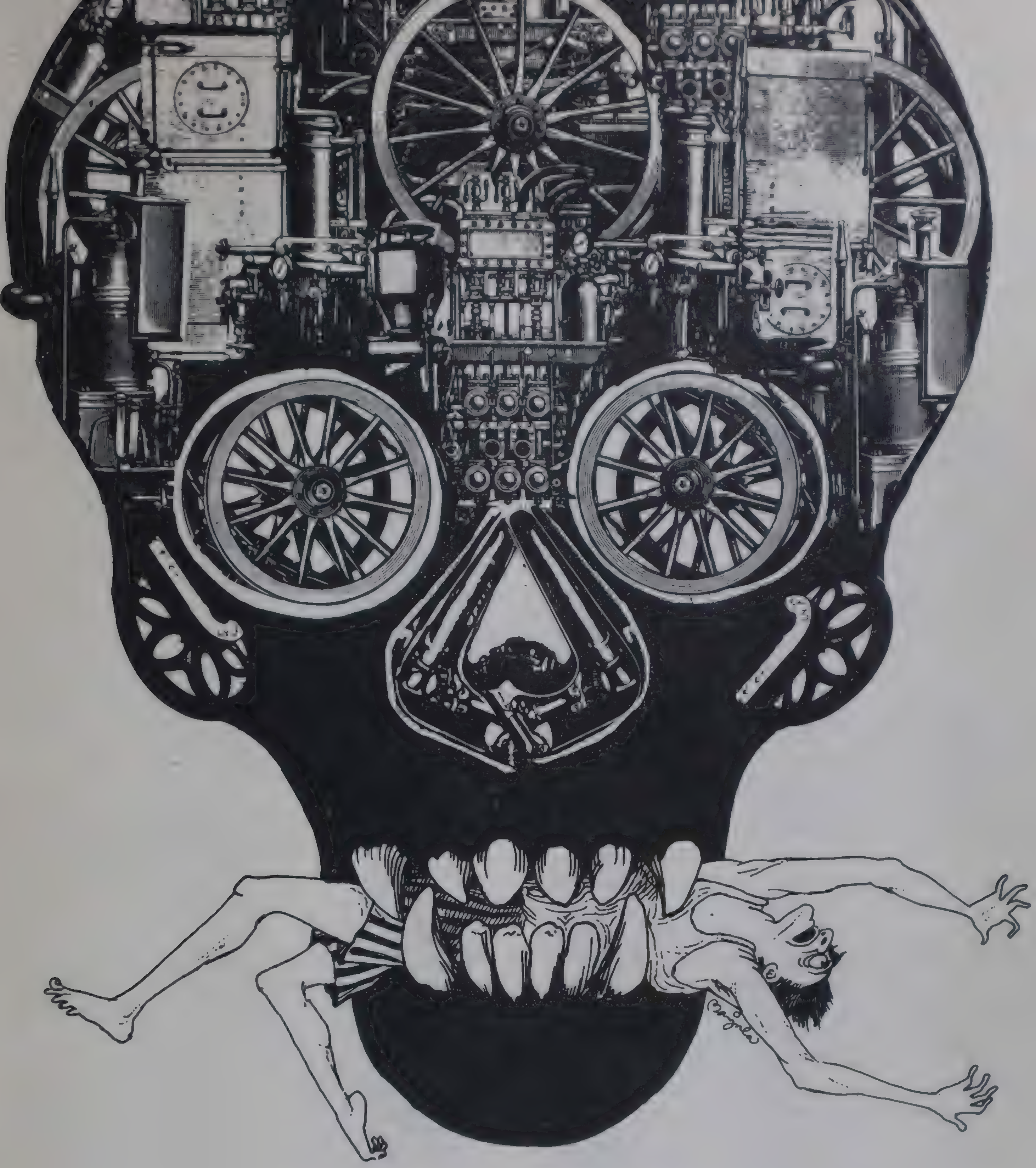
*The Bhopal plant—symbol of India's fascination with high technology and the Green Revolution—had been cleared by the Union Ministry of Chemicals. But the ministry had no idea whether, MIC, the released gas, was lethal.*

*Even as thousands sought urgent treatment, Union Carbide, the company, spread disinformation and confusion, and doctors argued over the right treatment. The majority died while being treated in hospitals.*

*Thousands of workers die every year because of occupational diseases, the gravest being caused by various types of dust. There is hardly a man alive over 40 years and hardly a house without a widow in Multanpur, in Madhya Pradesh, where the entire population is employed in slate pencil factories.*

*One million miners suffer from silicosis. As a result, "six out of 10 miners are physically unfit to undertake hazardous and back-breaking jobs," says a former president of the Indian Medical Association.*

*Mosquito-borne diseases are rapidly growing and are grossly undereported. Malaria researchers believe that incidence of malaria may be as high as 20 million, whereas official statistics claim only 2.16 million.*



Few people in India have paid attention to the debit side of industrialisation, especially to the growing dangers it poses to the health of people. Hardly a day passes when hundreds do not succumb to the ills of the industrialisation process. While most die a slow and steady death brought about by the growing pollution of the general environment and the increasing hazards in the occupational environment, others die in a cataclysmic way as thousands did in Bhopal. Bhopal has rudely woken India to the fact that the country's industrialisation has reached a stage when even catastrophic accidents can be expected.

Industrialisation is creating a high-risk environment for everyone. But experience shows that it is the poor who face the highest risks and dangers. They get the dirtiest, most hazardous of jobs and poverty forces them to live in the dirtiest environments. Yet few people pay any attention to their plight, and even fewer are prepared to do anything about it. Industrialisation strengthens the dual society, which in turn breeds callousness towards the sufferings of the underprivileged. Thus, hazards posed by industrialisation continue to grow while the society continues to neglect them.

The following chapter provides a vivid view of the health hazards posed by industrialisation. The first section deals with the growing problem of toxic wastes generated by industries, a problem that even the advanced countries have not been able to solve. The second section presents the experience of the Bhopal disaster. The essay describes a government that has not only failed to prevent the event but also to deal with its aftermath. The third section describes the dangers that Indian workers face everyday in their work environment, a subject that rarely attracts the attention of the general public, and often even the industrial worker. So marginalised is the poor worker in India that jobs and wages always take precedence over health and safety, and even trade unions have not taken up occupational health issues seriously. The last section on mosquito-borne diseases shows even while industrialisation presents its own growing hazards, the diseases of yesterday continue to be with us, and in full bloom.

# HAZARDOUS PRODUCTS

The world today produces chemicals faster that it can manage them. Nearly 5 million chemicals have been synthesised in the last 40 years at a rate of 10,000 new ones every month. Some 50,000 to 70,000 chemicals are used extensively in millions of different commercial products.

These chemicals include extremely toxic substances which can cause allergies, damage extremely vital organs of the human body like the eye, brain, liver, kidney and reproductive organs, produce malformations in unborn children and even generations to come, and cause or promote cancer, in quantities as small as parts per billion, equivalent to a few drops in an Olympic-size swimming pool. In case of accidental release into the environment in large quantities — as happened in the case of methyl isocyanate (MIC) in Bhopal — they can lead to mass death.

What is amazing is that the world knows so little about all the chemicals it uses. A recent US study indicated that no toxicological information whatsoever is available for about 80 per cent of all chemicals used in commerce. Not surprisingly, these chemicals keep throwing up surprises with their deadly properties.

A classic instance is that of a complex of chemicals known as polychlorinated biphenyls (PCBs). While investigating for DDT in animal and human fatty tissues, after a worldwide scare of DDT-quantities building up in the human body — with the highest quantities found in Indians — scientists in the 1960s came across yet another unexpected industrial chemical, which is widely used in the electrical industry, eventually identified as PCBs. Little was known till then about the toxic properties of PCBs, but being stable, they were dismissed as harmless. In 1968, however, there was an outbreak of an unusual and severe illness in Japan that ultimately affected over 1,000 people with 22 deaths. This serious outbreak was eventually traced to the consumption of rice oil that had been accidentally contaminated with PCBs.

The fatal effects of MIC, the gas that killed over 2500 in Bhopal, were little known to scientists until the disastrous event. No fatality was recorded until Bhopal. There are not even a dozen published papers available on the chemistry, health and environmental effects of MIC, though the gas was once screened as a chemical arms agent in 1944 by the University of Chicago's toxicity laboratory. Because it is difficult to stockpile — it is very volatile and difficult to control — MIC was reportedly not given priority as a chemical weapon over deadlier nerve gases. Two decades later, it made a splash on the commercial market as an intermediate in the manufacture of pesticides, but still without much research on how to cure an MIC-affected victim.

And, as far as public records go, MIC is relatively far safer than many others used in industry. In fact, the closely related toluene diisocyanate (TDI), which is used far more extensively in the plastic industry for making polyurethane foam has a permitted exposure level similar to MIC's, 20 parts per billion (ppb), but latest research shows that this ought to be reduced to 5 ppb because many workers chronically exposed to TDI at levels lower than 20 ppb become asthmatic. Another study conducted on women in a British car factory, who were cutting and sewing a new material for car seats — cropped nylon backed with flame-bonded polyurethane foam — found these women were showing increased respiratory problems, although they were exposed to only 0.3 ppb to 3 ppb of TDI.

Such chemicals — now an inevitable part of the industrialisation process and as a result constant companions of humankind — pose hazards to human health and environment in three different ways. Firstly, they expose workers — industrial workers and, increasingly, agricultural and plantation workers — to high health risks. Adverse health effects associated with exposure to chemicals in the work environment are being increasingly noticed in India (see section on Occupational Health). Secondly, through industrial wastes and effluents and runoff from agriculture, they steadily contaminate the environment and pose long-term risks to human health and the life of other biota. Occasionally, through accidental releases leading to catastrophic pollution, they can lead to mass death. Thirdly, as use of chemicals grows in products of daily life — as artificial sweeteners, flavouring and colouring agents, extenders of shelf-life in processed and packaged foods from milk to tomato sauce, as paints, detergents, cosmetics and manufactured drugs, and as various forms of plastics and fibres—they pose an insidious threat to human health. Today chemicals are all around—in the workplace, in homes, and in food and drink. Our modern drinks like the colas are, in fact, nothing but chemical drinks. So extensive is the use of chemicals today that some environmentalists have described this trend as the "growing chemicalisation of our

**Residential colonies and chemical factories coexist in the polluted environment of Chembur, also known as 'Gas Chembur'. (Indian Express)**

lifestyle".

To take an example, lead, a dangerous metal, today exists all around a modern human being: in water-pipes, in many pesticides, in industries which involve lead smelting and refining, storage batteries, lead-based paint, ceramic crockery, containers with lead glaze, copperware lined with impure tin containing lead, in newspaper and magazine ink. People in cities are exposed to lead in car exhaust fumes. Those living around steel mills are exposed to leaden air — a 2.5 million tonne capacity plant means 80 kg of lead settling on every square kilometre in the vicinity of the plant. Liquor consumers can sometimes take in fatal quantities of lead if the spurious liquor has been made in a home-made still constructed from scrap automobile parts

With industrialisation, the use of chemicals will inevitably grow and pose increasing risks to human health and environment. The wastes generated from the manufacture of various chemicals and from their subsequent use are posing such a serious problem that disposal of hazardous wastes is probably USA's number one environmental problem today. An American environmental group, the Natural Resources Defence Council estimates that there are as many as 50,000 toxic waste dumps already in the US, with 25 million tonnes of toxic wastes being generated every year.

At least 14,000 of the existing dumps are or soon could be dangerous, with their contents dripping into soil or water supplies. The full effect of these gradual seepages may not be felt for 10 to 15 years, the time it takes for some cancers to be recognised. In August 1984, the US Congress voted to increase the government 'Superfund' to clean up these sites to $ 10.1 million over the next five years. A few years ago, there was a major scandal when it was found that an American toxic waste disposal company had bribed the Sierra Leone government into permission for setting up a toxic wastes dump. Investigators later found that the Sierra Leone incident may just have been the tip of an iceberg. US toxic waste disposal companies have reportedly approached a number of other countries, including Chile, Somalia, Haiti, Nigeria and Senegal.

The most well known example of a hazardous waste site in the US is Love Canal near Niagara Falls. Millions of barrels of industrial wastes had been dumped into a site as landfill, which was then covered in the 1950s. Soon residential houses were built on it. But by the early 1970s, the basements of the homes were flooded with black ooze and people were complaining of asthma, kidney disease, hepatitis and birth defects. In 1978, dozens of families were evacuated and some of the houses had to be bought from them by the government.

Despite a right-wing swing in the US and his re-election, President Ronald Reagan has had to backtrack on his anti-environment stand. All public opinion polls in the US have shown that the majority of the US public support the environmentalists. The poor are extremely concerned about toxic wastes, because they are either dumped largely in so-called backward areas, such as the Appalachian mountains, or near the homes of the poor, where land costs are cheap. No toxic waste dump is created near an elite residential area, where land costs are high.

The problem of toxic hazards is already reaching alarming proportions in India and is bound to grow with increasing industrialisation. The Indian chemical industry has grown phenomenally since independence. There are today an estimated 4,000 chemical factories with an investment of over Rs 3,000 crore which employ 3.8 lakh. The chemical industry accounts for 20 per cent of fixed assets in industry and produces more than Rs 6,000 crore worth of goods every year.

**Growth of industries dealing with toxic chemicals and generating toxic and hazardous wastes**

| | Production (thousand tonnes) | | |
|---|---|---|---|
| | 1950 | 1970 | 1980 |
| Pesticides | NA | 3.00 | 40.68 |
| Fertilisers (nitrogenous and phosphatic) | 18 | 1059 | 3005 |
| Dyes and pigments | NA | 13.55 | 30.85 |
| Pharmaceuticals | 0.25* | 1.79 | 5.07 |
| Organic chemicals including petrochemicals | 200 | 17100 | 24100 |
| Steel (ingots) | 1500 | 6500 | 8000 |
| Non-ferrous metals | | | |
| Copper | NA | 9.30 | 18.80 |
| Lead | NA | 1.86 | 11.40 |
| Zinc | NA | 23.41 | 52.70 |
| Caustic Soda | 11 | 304 | 457 |

Notes: NA — Not Available
*Value for year 1952

Source; B.B. Sundaresan, P.V.R. Subrahmanyam and A.D. Bhide, An overview of toxic and hazardous waste in India, Industry and Environment, Special Issue 1983.

The alkali industry has grown ten-fold since 1947. With a total licensed capacity of 78,000 tonnes, India is the largest manufacturer of pesticides in South Asia and Africa combined. Total dyestuffs production in India during 1975 was around 18,500 tonnes and is expected to increase 2.5 times to 46,000 tonnes by 1989. As many as 139 organic chemicals, heavy metals like zinc, lead, chromium, copper, mercury and molybdenum and their compounds, and various acids and alkalis are used in dye manufacture.

Statistics on injuries and deaths in industries are highly inadequate but those that exist show that the chemical industry kills more workers every year than any other industry — 100 workers were killed (33 per 100,000 employed) and about 11,000 injured in chemicals and chemical products industries in 1980. Every non-fatal injury resulted in a loss of 10.6 days a year. The biggest cause of death was explosions, and spills and leakages of chemicals are common. Maharashtra and Gujarat with the maximum number of chemical plants recorded the maximum number of accidents.

The Bhopal disaster has brought home the hazards of toxic substances with full force. But there have been several, relatively minor, disasters before. The first recorded episode of hazardous waste release is probably that of Monghyr, Bihar, in 1968 when the river Ganga was set aflame. Discharge of oil from a refinery effluent led to the fire and resulted in the suspension of water supply to Monghyr town and closure of the refinery for a short period. But regular reports of fish kills in estuaries, rivers and other water bodies and of the death of cattle due to toxic substances such as arsenic, heavy metals and acids indicate that such occurrences are frequent.

## Other Bhopals

There are other possible Bhopals in India. Baroda, with a population of a million, has the country's single largest concentration of heavy petrochemical industries on its periphery. The industrial complexes include state-owned units like Indian Oil Corporation's Koyali refinery, one of the biggest in Asia, Indian Petrochemicals Corporation Ltd (IPCL), Gujarat State Fertilizer Company Ltd (GSFC), Gujarat Alkali and Chemicals Ltd (GACL) and the Atomic Energy Commission's Heavy Water Project. In addition, there are a number of private chemical companies, large and small, and about 500 other medium and small industries in the industrial estate of Nandesari.

These industries are directly dependent on the Koyali refinery and the IPCL, and they produce highly inflammable and toxic materials, deadly gases and liquids. For example, IPCL produces the highly dangerous hydrogen cyanide (HCN) which is supplied to two local industries. Immediately after Bhopal, IPCL had to issue a soothing statement saying that it did not store any HCN, and that several automatic safety mechanisms would ensure the safety of the people living in surrounding areas in case of accidents.

Accidents have happened in Baroda. In December 1977, an explosion took place at the Heavy Water Project close to the GSFC complex, which rendered it ineffective for two years. Fortunately, the blast was self contained and a major disaster was averted. A huge fire broke out at the Koyali refinery's new LPG bottling plant in June 1983, injuring five workers and sending splinters of gas cylinders crashing through the plant roof. Had these splinters hit any of the three tanks storing liquid ammonia, 100 ft away, there would have been a major disaster.

An accidental leakage of chlorine, one night in October 1981, from a plant at Nandesari Industrial Estate left 30 cows dead and four shepherds unconscious at the nearby Anghad village. An ammonia tanker met with an accident in a thickly populated part of Baroda in August 1984 and released gas that killed a 50-year old woman and hospitalised 20 persons; 70 others were mildly affected and 60 heads of cattle, fowl and pets died. Again in December 1984, about a fortnight after the Bhopal disaster, another tanker carrying 10 tonnes of sulphuric acid turned turtle on the outskirts of the city around midnight killing one child and the fumes sent hundreds of people rushing out of their homes looking for safety.

Times of India

These are just minor incidents compared to what may happen in the wake of a major accident — or terrorist attack — which could start a chain of detonations or reactions in others, throwing a cloud of toxic vapour around Baroda. Pollution is already becoming unbearable; trees, crops and vegetation killed by sulphur dioxide emissions from industrial plants can be seen along the national highway leading into Baroda. The GACL releases chlorine, hydrochloric acid and mercury in its effluents. The GSFC every day sends out noxious fumes from its huge waste incinerator.

The Gujarat Water and Air Pollution Control Board is helpless. But people have begun to protest. A group of farmers is demanding compensation from GACL for the destruction of their crops on account of a gas leakage on August 30, 1984. The GSFC is already quietly paying farmers in the surrounding region several lakhs of rupees every year to compensate for crops lost to sulphur dioxide fumes. IPCL had to pay the 1000-odd inhabitants of Dhanora, a tiny village outside Baroda, who had the backing of ruling party politicians, Rs 28 lakh for resettlement elsewhere and as compensation for crop losses.

The Bhopal scare frightened the Gujarat government into ordering suspension of production for about a month in at least 10 pesticide plants in the state and 15 other units using toxic gases. The plants are to be inspected by the state pollution control board. Following its neighbour's lead, Maharashtra announced in early January that a committee would review safety measures in three dozen industrial units identified as hazardous, mostly located in industrial estates at Chembur, Sewri, Jogeshwari, Tarapur and on the Thane-Belapur road.

The Maharashtra Pollution Control Board has taken a strong stand in the case of the giant public sector Thal-Vaishet fertiliser plant of Rashtriya Chemicals and Fertilisers in Raigad district. In mid-December there was a report that an ammonia leak from the plant had killed a boy. The autopsy report did not confirm death due to gassing but the autopsy was admittedly conducted well over 24 hours after death. The board's officials also found no leak though villagers kept complaining of ammonia emissions. Finally, it was found that "fantastically high concentrations of ammonia" were being let out in the effluent, which was making its way into the Navagaon creek, affecting the fish. In its eagerness to start up the plant, the company was letting the effluent go untreated. The company has also not lined its effluent storage pits with polythene, thus posting an extremely serious threat to the groundwater. The board has served an order on the company to stop discharging all effluents that do not conform to the stipulations cited in the no objection certificate.

West Bengal has identified 400 chemical factories that deal with poisonous gases. It is also reviewing safety steps at the LPG bottling plant in Kalyani. Uttar Pradesh in its turn, has identified 18 hazardous industrial units and is waiting for an expert report on their safety measures. Similarly, Rajasthan has set up a committee to review safety and pollution control measures in pesticides, zinc, chloralkali and other hazardous plants. In Delhi attention is centred on factories in Faridabad and on the two neighbouring chemical factories — Hindustan Insecticides, a major producer of DDT, and DCM Chemicals — at Najafgarh. Some 40 schoolchildren had become unconscious near the factories in October 1982. Residents of adjoining colonies complained of toxic fumes especially during winter months when the cold brings about inversions.

The Central government has meanwhile suspended production at all the 17 methyl isocyanate (MIC) based pesticide plants in the country. All are in the small-scale sector and used to get the MIC gas from the Bhopal plant. The safety factors involved in small-scale pesticides production are to be reviewed by the director-general of the Council of Scientific and Industrial Research. The government has also announced the establishment of a cell to review safety practices in developed countries and suggest regulations, control and preventive measures relating to the manufacture of hazardous chemicals.

DANGER! DANGER!
GAS
KILLS WITHOUT WARNING
KEEP AWAY FROM GAS!
खतरा
खतरा
गैस
बिना सूचना
गैस से हमेशा
दिये मार डालती है
दूर रहो

An ominous sign at the TISCO steel plant in Jamshedpur, which employs 40,000 workers. (ILO)

**Generators of toxics**

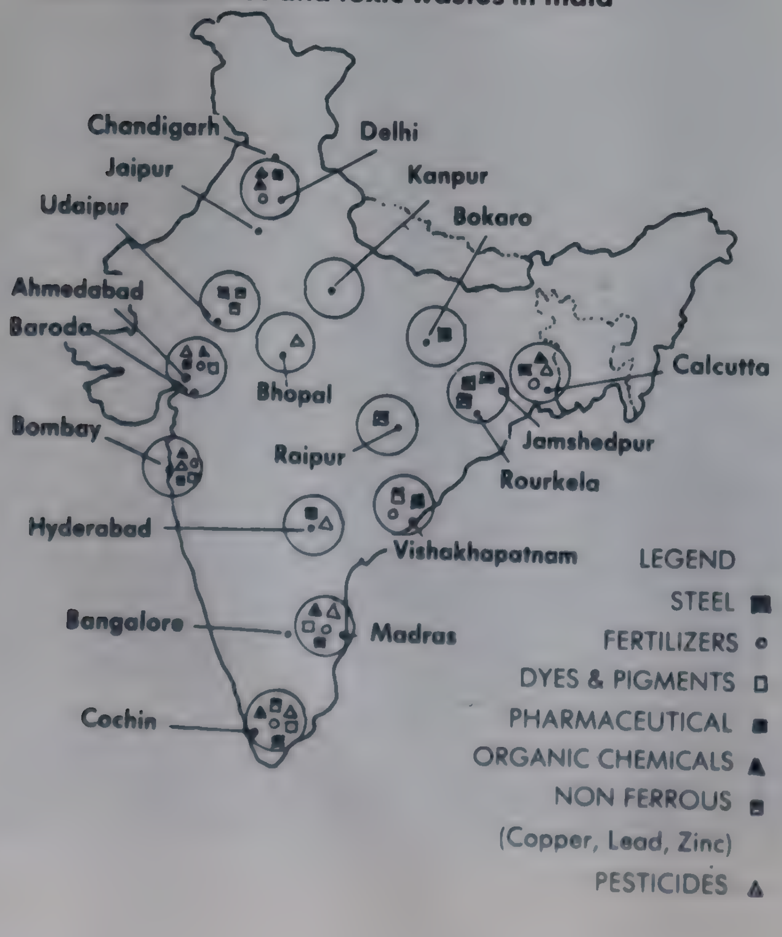
Industries which are known to produce potentially toxic and hazardous wastes are pesticides, dyes and pigments, organic chemicals, fertilisers, non-ferrous metals, steel and chloralkali manufacturing plants. The major foci of such industries are Delhi, Udaipur, Kanpur, Chandigarh, Bokaro, Jamshedpur, Rourkela, Calcutta, Raipur, Ahmedabad, Baroda, Bombay, Hyderabad, Visakhapatnam, Bangalore, Madras and Cochin. Ironically, in this list of settlements prepared by scientists of the National Environmental Engineering Research Institute (NEERI), Bhopal does not occur, which only shows that even isolated factories can become centres of major disasters.

In terms of the type of wastes generated, industries can be divided into two categories. Phosphatic fertiliser factories and thermal power plants generate large quantities of conventional solid wastes which are usually stored near the site. Organic and inorganic chemical industries generate both liquid and solid wastes, which are not voluminous but of which some have a high toxic and hazard potential.

In the phosphatic fertiliser industry, about 5 tonnes of wet phospho-gypsum are generated per tonne of phosphatic fertiliser ($P_2O_5$) produced. In 1980, some 3.5 million tonnes of the byproduct phospho-gypsum (BPG) was generated at the 11 major phosphatic fertiliser plants. About a fifth of this BPG was used to produce ammonium sulphate and the rest, containing thousands of tonnes of heavy metals and toxic substances such as cadmium, chromium, copper, lead, manganese and fluorides, was used for landfilling or dumped into lagoons in the form of slurry. The available land for disposal is nearly exhausted in most of the factories surveyed by NEERI. The lagoons are overflowing into surface waters like streams and ponds and toxic substances are leaching from dump sites into groundwater.

Extensive use of phosphatic fertilisers can also cause serious environmental pollution. Traces of toxic metals present in the mineral rock phosphate get concentrated during manufacture of superphosphates. As a result, levels of fluorides and cadmium tend to build up in soils treated by phosphatic fertilisers, and these toxic elements can be later accumulated in dangerous quantities by food crops. "With an expected consumption of 1.3 million tonnes of phosphate fertilisers by 1983-84, there is need to compute the load of cadmium pollution from this source," says C.R. Krishna Murti, a former director of the Industrial Toxicological Research Centre in Lucknow.

**Foci of hazardous and toxic wastes in India**



Thermal power plants, which produce more than half the electricity generated in India, are other major sources of solid wastes. Indian coal has a high ash content, which in 1980 resulted in 16.6 million tonnes of fly ash being produced at power station sites. With the increase in thermal power capacity, the fly ash problem is destined to grow. Fly ash also contains toxic metals such as zinc, barium, copper, arsenic, vanadium, thallium and manganese. Fly ash is usually collected in dry form to make mountainous heaps near the power station or is carried as slurry into ponds and rivers where it creates serious water pollution problems. When fly ash is dumped on low-lying lands, toxic metals from it can also leach into the groundwater.

Chemical industries produce highly toxic wastes. The disposal methods of the industry are still very primitive, with landfilling being the major practice. Generally the industry neutralises the toxic waste water from the plants with lime and the neutralised liquid effluents, which are still highly toxic, are discharged into rivers and ponds with little or no treatment. The sludge and other solid and semi-solid wastes are disposed off on fallow public land. "No data on the effects of such disposal are available," says a NEERI report.

The pesticide industry has grown rapidly and today produces a range of products from DDT and BHC to carbamates. This industry produces highly toxic wastes. The annual production of DDT is about 14,000 tonnes. The 28,000 tonnes of sludge obtained every year at DDT plants in India, after treatment of the highly corrosive and toxic waste water, still contains nearly 14 tonnes of DDT. This sludge is usually dumped on low lying areas and the leachate pollutes both ground and surface waters. Annual production of BHC is 41,000 tonnes; it is believed that some 1.5 tonnes of BHC are lost in treated effluent and another 15 tonnes in sludge.

A variety of carbamates are also manufactured in India. The production of Sevin — the pesticide that was being produced in the Union Carbide factory at Bhopal — produces large quantities of waste water containing foul-smelling mercaptans, some quantities of the pesticide itself and other toxic substances like alphanaphthol. The waste water is neutralised with lime and the remaining water is solar-evaporated in polythene-lined ponds. Every 1,000 kg of Sevin generates about 50 kg of the toxic sludge, which is then disposed of as landfill, often without adequate precautions. It is common practice for the pesticide industry to collect all the toxic solid wastes in containers and store them for disposal by burying in specially constructed pits within the factory premises. "No information is readily forthcoming on the actual method of their disposal," says NEERI.

The dyes and pigments industry is another major producer of toxic waste. Some of the organics and the intermediates used in this industry are known to be highly toxic and bladder cancer has occurred among workers. The

**Selected list of toxic chemicals for control**

| | Use | Hazard |
|---|---|---|
| Acrylonitrile | Acrylic fibres/synthetic rubber plastics | Highly toxic/carcinogenic/teratogenic |
| Arsenic | Pesticides/Unani medicines/glass | Toxic/dermatitis/muscular paralysis/damage to liver and kidney/possibly carcinogenic and teratogenic |
| Asbestos | Roofing/insulation/air-conditioning conduits/plastics/fibre/paper | Carcinogenic to workers and even family members |
| Benzene | Octane number of gasoline/manufacture of many chemicals | Leukemia/chromosomal damage in exposed workers/behavioural changes |
| Beryllium | Aerospace industry/ceramic parts/household appliances | Fatal lung disease/heart and lung toxicity |
| Cadmium | Electroplating/plastics/pigments/superphosphate fertilisers | Kidney damage/emphysema/possibly carcinogenic, teratogenic and mutagenic |
| Chlorinated organics (DDT, BHC, etc) | Pesticides/Fumigant | Depression of central nervous system/possibly carcinogenic |
| Chromates | Tanning/paints/pigments/corrosion inhibition/fungicides | Skin ulcers/kidney inflammation/possibly carcinogenic/toxic to fish |
| Lead | Pipes/storage batteries/paints/printing/plastics/gasoline additive | Intoxicant/neurotoxin/affects blood system |
| Manganese | Mining/welding/dry cell battery/ferromanganese | Nervous damage/damage to reproductive system |
| Mercury | Chloralkali cells/fungicides/Pharmaceuticals | Nervous damage/kidney damage |
| Polychlorobiphenyls | Transformers/insulation of electricity | Possibly carcinogenic/nerve, skin and liver damage |
| Sulphur dioxide | Sugar/bleeding agent/pollution from coalbased power stations | Irritation to eyes and respiratory system/damage to plants and monuments |
| Urea | Fertiliser | Bronchial problems/Kidney damage |
| Vinyl chloride | Plastics/organic compounds synthesis | Systemically toxic/carcinogenic |

Source: C.R. Krishnamurthi, Toxic Chemicals, in State of the Environment: Some Aspects, National Committee on Environmental Planning, New Delhi.

sludge along with other solid and semi-solid wastes is normally carted out and disposed of on fallow — and public — land.

Titanium dioxide is used in pigment manufacture. Production of titanium also generates massive quantities of highly toxic effluents and solid wastes. NEERI has recommended that the treated sludge should be carefully dewatered, and refilled in abandoned ilmenite mines. Ilmenite is the ore from which titanium dioxide is extracted.

The nitrogeneous fertiliser industry is yet another major source of arsenic and chromate wastes. Though arsenic oxide is used in a closed loop system in many urea plants, spillages are common. The spillages are usually collected in solar evaporation ponds and the sludge is stored in steel drums, sealed and kept within factory premises for final disposal. Refineries and urea manufacturing plants also use chromates in cooling water for corrosion inhibition. A 1000 tonne a day urea plant can produce nearly 25 kg of chromates in its waste water. Again the sludge from the waste water treatment plant is used for landfilling or sometimes even just sent off with the treated effluents into ponds and rivers.

From the toxic hazards point of view, petrochemical, coal and ethanol-based organic chemical complexes are the most potent sources of established mutagenic and carcinogenic chemicals. There is an urgent need to monitor these organic chemicals even though they are biodegradable. Cancer, as a result of exposure to important and widely used organic chemicals like acrylonitrile, acrylamide and vinyl chloride, takes years to appear. Medical surveillance of workers employed in these industries and their families is of utmost importance in early detection of cancer. Plastics, polymers, artificial fibres, synthetic dyes, drugs and pharmaceuticals and pesticides are industries which use these organic chemicals. All these industries are expected to register significant growth rates in the next few decades.

The basic organic chemicals industry produces a range of highly toxic tarry residues. Until recently all these residues were disposed off on fallow land together with the sludge generated by the waste water treatment plants. A few factories have now installed an incinerator for all the solid wastes. But most factories are reluctant to instal incinerators. The equipment cost alone runs into several crores and running costs can be around Rs 50,000 a day.

The chloralkali industry has also grown rapidly. Paper and rayon industries use large quantities of caustic soda and soda ash. A team of Japanese environmentalists working with Minamata victims which recently visited India was shocked to find that many chloralkali plants in India are still based on the old process which uses mercury. This process was discarded in Japan after the horrific Minamata disease was discovered in the 1960s. The country imports around 200 tonnes of mercury, of which 180 tonnes are used by the chloralkali industry alone, and most of it finally goes out in waste waters and sludge, and from there into the environment. Minamata disease has not been reported in India but this may only be because nobody has yet looked

## Banned Pesticides

Pesticide use in India has multiplied 20 times between 1960 and 1980 and it is estimated that the nearly 100,000 tonnes of pesticides which will be consumed in 1984-85 will help the country save slightly over 10 per cent of foodgrains production. India's hunger for pesticides can be estimated from the fact that although indigenous production has grown at the rapid rate of 14 per cent in the eighties — 43,000 tonnes in 1980-81 — imports exploded seven times, in terms of value, in three short years from 1978 to 1980. By 1989-90, pesticide consumption is expected to average 120,000 tonnes. The agricultural sector accounts for two-thirds of consumption, and five states — Punjab, Gujarat, Andhra Pradesh, Tamil Nadu and Maharashtra — use over 50 per cent of that.

In terms of tonnage, at least 70 per cent of all pesticides consumed on Indian farms are banned or severely restricted in Western countries and identified by the WHO as excessively toxic or hazardous. The proportion is even higher in the case of pesticides used in public health programmes such as malaria eradication. For instance, DDT, banned many years ago in several countries because it leaves intolerably high residues in soil, water, food and the human body and is suspected to be a carcinogenic, is used liberally in India. Current annual consumption of DDT is 3,500 tonnes in agriculture used over an area exceeding 2.5 million hectares and 4,000 tonnes in public health.

Another danger substance is BHC, two and a half times as toxic as DDT, banned in European Economic Community (EEC) countries, suspended and cancelled in the US, and also a suspected carcinogen, but which covers 8 per cent of the country's net sown area; estimated consumption in 1982: 33,000 tonnes. Methyl parathion, 20 times more toxic than DDT, is also banned in the West, but 3,000 tonnes is consumed every year in India, over 12 million hectares, the highest coverage for any pesticide. Heptachlor, three times more toxic than DDT, banned in the US and withdrawn from the UK, is still consumed in India: 150 tonnes annually. DBCP (dibromochloropropane), banned in the US for producing infertility and stomach cancer, is used in India on wheat and other crops. Herbicide 2,4-D is a basic ingredient of "Agent Orange", the defoliant used with brutal effect in Vietnam. India has an installed manufacturing capacity of 1,135 tonnes for this herbicide, and an annual coverage of 3.33 lakh hectares.

India's insecticide regulators have approved some of the most toxic pesticides like Phosvel, Dieldrin and Chlordane. In fact EPN, an insecticide that has been banned in other parts of the world, has been listed by the UN as 'not approved for registration' by India; it is, however, in the list of approved pesticides for 1983. Lindane (severely restricted in the US), Aldicarb (categorised as extremely hazardous by WHO), carbofuran, monocrotophos, oxydemetonmethyl 1, DDVP (all categorised as highly hazardous by WHO) are used in the country today.

India has an Insecticide Act, which empowers authorities to monitor the registration, packing, labelling, import, manufacture, sale and use of pesticides. Before a pesticide is registered, the Central Insecticides Board scrutinises data on the acute, long-term toxicity and the antidote. But it ensures no safety measures beyond the mandatory danger label. In addition, the world's leading exporter of pesticides, the United States—16.5 per cent of total exports and the EEC—5.15 per cent of exports — exercise little or no control over the export of banned pesticides. In 1976, for instance, some 30 per cent of US exports were of products whose use has been banned in the US.

The effect of this indiscriminate use of pesticides is as expected. According to Praful Bidwai, writing in 'The Times of India', India may account for a third or more of all the 500,000 cases of pesticide poisoning estimated by WHO to occur every year in the underdeveloped countries. Individual instances of pesticide poisoning are rarely reported for tracing it to a pesticide is a long process. The worst affected are the agricultural and the anti-malaria workers who spray and apply pesticides. At the Indian Science Congress in 1985, Devika Nag and U.K. Misra of the King George Medical College, Lucknow, said that workers who sprayed these agrochemicals reported visual impairment, dislike of bright light and night blindness. Nag added that exposure to these pesticides led to mental disturbances, anxiety, insomnia and depression. There is evidence to show that areas of high pesticide use also have a high incidence of paralysis.

No one is secure. A recent WHO study, which analysed cereals, pulses, milk, eggs and meat samples from across the country found that 50 per cent of the samples contained pesticide residues and in more than 30 per cent of the samples, the residues were far in excess of the tolerance limit. Studies done by the Indian Agricultural Research Institute, Delhi, show that pesticide residues in vegetables coming to Delhi markets are 20 times the permissible limit. Samples of bottled milk in Maharashtra were found to contain 4.8 parts per million (ppm) to 6.3 ppm of DDT and 1.9 ppm to 6.3 ppm of dieldrin in about 70 per cent of the samples analysed. The permissible limit for the two compounds in milk is 0.66 ppm. A study by G.S. Dhariwal and R.L. Kalra, of the Punjab Agricultural University found that all samples of milk from around Ludhiana contained DDT and 73 per cent had residues more than the tolerance limit. Drunk by a three-month-old child every day, would result in a DDT intake nine times higher than that acceptable. In fact, DDT and BHC residues were found to be present in all 75 samples of human milk collected from Punjab. The babies were drinking 21 times the accepted daily intake of DDT and BHC from their mother's milk.

Bhopal has brought to light another pesticide hazard, the raw materials and intermediates manufactured and stored at the plants. Very little is known about these processes or the toxicity of the chemicals involved. 'The Economic Times' recently reported that a leading pesticide unit located at Jogeshwari in Bombay which manufactures ethylene dibromide, a highly toxic pesticide included in the UN list of banned products and described by the National Cancer Institute in the US "as the most potent cancer causing substance found in the animal test programme", is now putting up a plant to manufacture glyphosphate. They intend to use chloromethylphosphonic acid (CPA) in the process; CPA is a chemical used in chemical warfare.

Another hazard is the possibility of misuse of such chemicals by the manufacturers. In June and October 1975, Hindustan Ciba Geigy Ltd tested the safety of its Nuvacron pesticide on more than 40 Indian volunteers aged between 13 and 57. All of them stood around while an aircraft loaded with the pesticide solution sprayed them with it over four days. This use of humans as guinea pigs was reportedly approved by WHO and had the sanction of the Indian Insecticide Act which requires that aerial spraying measurements be done under practical conditions to prove the safety of the chemical.

Indiscriminate use of pesticides leads to diminishing returns. A recent FAO study found that in 1980, 432 species of arthropods were resistant to at least one, and often several insecticides, an increase from 25 in 1954. In Gujarat, cotton farmers spray their fields 20 to 30 times more often than before with more toxic and expensive pesticides, which today account for over half of cotton cultivation costs. In the Vidarbha region of Maharashtra, expenditure on chemicals has increased 340 per cent in the years without any increase in the average yield. In Andhra Pradesh, the state with the highest consumption of pesticides at a staggering 15,000 tonnes a year, at least 15 species of pests have become resistant to all commonly-used agrochemicals.

In fact, the spectacular spurt in pesticide use has resulted in secondary pest outbreaks, because the chemicals have killed off natural enemies of pests like birds, spiders and worms. Such outbreaks are sometimes more destructive than the primary pestilence and much more difficult to control.

for it. Indian scientists are well aware that the mercury load in estuaries and water sources near chloralkali, paper and rayon firms is increasing.

Non-ferrous metallurgical plants producing copper, lead and zinc are also major generators of toxic wastes. So are steel plants which generate about a million tonnes of tar sludge from coke oven plants.

Small industries also deal with many toxic substances. India produces about 100 million pieces of hides and skins, and for every tonne of hides and skins processed, 3.5 kg to 4.5 kg of trivalent chromium gets discharged as waste. Even firms dealing with electroplating and traditional occupations like bangle making, processing of natural fibres and goldsmithy have to deal with toxic chemicals.

**Accidents during storage and transport of chemicals**

A massive and uncontrolled explosion of the type that occurred in Bhopal releasing toxic gases and fumes is rare only in terms of its scale. Several explosive accidents have occurred during storage and transport of chemicals. Except for newspaper reports there is no proper documentation of such accidents. A major accident occurred in Delhi in September 1984 but it failed to attract continuing press attention presumably because nobody died. Toxic gas and fumes had spread over an area of one sq km following an explosion in a godown. Two school children fainted and two labourers working in the godown received burn injuries. Like the Bhopal incident, the society was unprepared to deal even with this small accident.

Apparently, six wagon loads of chemical substances comprising of bags of a highly toxic pesticide, BHC, and containers of sodium were stored in the godown. Rainwater leaked into the godown and came in contact with sodium, which caught fire and exploded. The sodium reacted with BHC to form toxic fumes. As the fumes looked like smoke from a fire, the fire brigade was called in. The water from their hose pipes only worsened the situation.

Since the Bhopal incident, Indian newspapers have reported several other accidents in which people have been killed. First, three people died and three others fell critically ill when a liquid ammonia tanker collided with an empty oil tanker near Chandigarh. A week later, a year-old girl died and three others were injured when a tanker carrying sulphuric acid turned turtle near Baroda. The incident occurred shortly after midnight and hundreds ran out of their homes because of the fumes. About a fortnight later, 47 people were seriously affected when two chemicals got accidentally mixed in a factory near Cochin releasing large quantities of chlorine. In early January, gas leaked from four drums of sodium hydrosulphite kept at a transport warehouse in Jabalpur affecting 100 people and sending thousands of others running helter-skelter. Reports of similar incidents have poured in from all over the world.

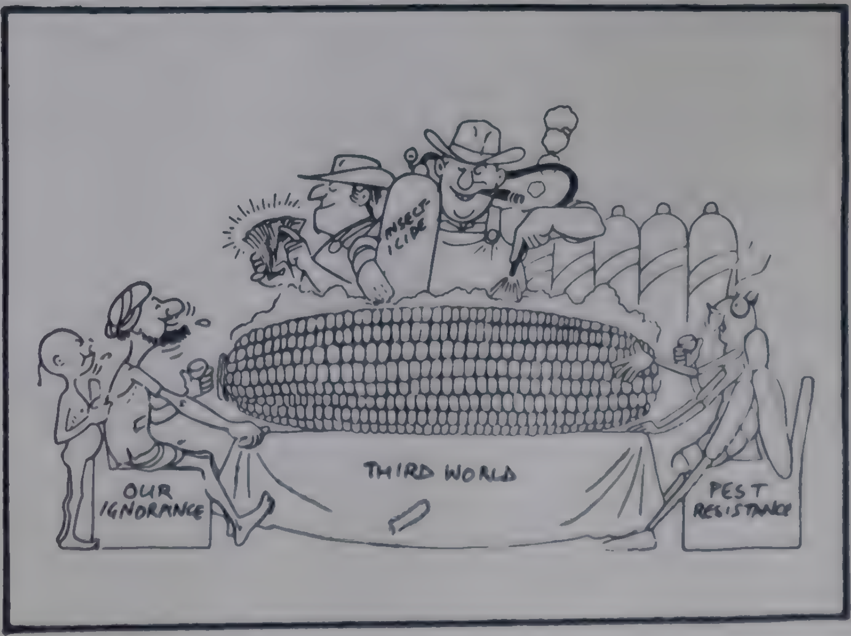
Ports are also dangerous places in India. In 1980 alone, 99 accidents occurred in Indian ports during the handling of some 5600 tonnes of fertilisers and raw materials for their manufacture. The All India Port and Dock Workers Federation recently alleged that dock workers are regularly exposed to hazardous chemicals while unloading them. Because of bureaucratic procedures, hazardous goods if unclaimed, do not get auctioned, and for years lie around with corroded metal casings and chemicals oozing out. Hazardous materials transferred from ships to barges often remain on these barges for months. Sheds with chemical drums are situated next to warehouses for dry fruits. Fire-fighting arrangements are non-existent.

**Problems in use**

Industrialised agriculture, more popularly known as green revolution agriculture, has promoted an extraordinary use of dangerous chemicals in the form of pesticides, weedicides and fertilisers. Pesticide residues now appear in all varieties of foods like fish, fruit, vegetables and milk and often expose human populations to acutely dangerous chemicals. The first report of poisoning with pesticides came from Kerala in which some 100 people died after eating wheat flour contaminated with parathion. Since then more than 25 incidents of insecticide poisoning have occurred affecting anywhere from a few individuals to large groups. Many hundreds of smaller incidents could have gone unrecorded. In Lakhimpur Kheri, 250 persons in 26 villages were affected with BHC poisoning after consumption of BHC-contaminated food. Investigations showed brain damage to affected persons. Recently in Andhra Pradesh a large number of villagers contracted the now well known "Handigodu Syndrome" after eating pesticide-contaminated crab meat.

Domestic accidents account for thousands of deaths and disabilities each year. In most of the domestic accidents and suicides, poisonous chemicals are involved. Data collected by the Bureau of Police Research and Development reveals that poisoning was the cause of 5,973 accidental and 9,781 suicidal deaths during 1980. Poisoning cases due to ingestion of kerosene or agrochemicals by children are also very common. Burns due to exploding LPG cylinders in middle and upper class homes is increasingly an important cause of domestic accidents. In 1980, 491 accidental deaths were reported as due to explosions.

The danger of chemical hazards is slowly moving into non-industrialised rural areas because of the increasing use of chemical products. "Plastic containers for storing water or articles of food, artificial colouring agents in processed food, cheap cosmetics and detergents are sold in rural markets and fairs. They constitute sources for the diffusion of toxic chemicals, the impact of which on the rural ecosystem has yet to be assessed," says Krishna Murti.



### Regulatory situation

Despite the growing problem of chemical safety, there are still no systematic regulations in India. Firstly, the data base is extremely poor. There is no proper documentation of accidents every year. Even less is known about the diseases caused among workers by exposure to very small amounts of toxic chemicals in vapour or gaseous form in the workroom atmosphere.

In the US, an accidental death is defined as one which occurs within a year of the accident. In India, accidental deaths are generally those which occur immediately or soon after the event and get reported to the police or agencies like the factory inspectorates and employees state insurance corporations. A number of accidents have occurred during storage, handling and transport of chemicals and hazardous products but again there is no documentation available on these accidents.

**Legislation dealing with chemical safety**

| | |
|---|---|
| **Industry** | |
| Protection of workers' health | Mines act, 1852<br>Indian Railway Act, 1890<br>Factories Act, 1948<br>Dock Labourers Regulation, 1948 |
| Usage of restricted chemicals | White Phosphorus Act, 1923<br>Hazardous Occupation (Lead rule), 1937 |
| Usage of Explosives | Indian Explosive Act, 1884 |
| Usage of other chemicals | Indian Boilers Act, 1923<br>Petroleum Act, 1934<br>Organic Solvent (rubber) Rule, 1937<br>Chromium Rule, 1937 |
| **Food and Agriculture** | |
| | Prevention of Food Adulteration Act, 1954<br>Insecticides Act, 1965 |
| **Environmental Pollution** | |
| | Bengal Smoke Nuisance Act, 1905<br>Factories Act, 1948<br>Industries Act, 1951<br>River Board Act, 1956<br>Mines and Minerals Act, 1957<br>Merchant Shipping Act, 1970<br>Water (Prevention and Control of Pollution) Act, 1974<br>Air Act, 1981 |

Source: SH. Zaidi and S.J. Arcievala, Chemical Safety situation in five countries of the Southeast Asia region, WHO, New Delhi, 1984.

A number of acts in the country demand that accidents be immediately reported. Accidents dealing with explosion of LPG cylinders or cylinders carrying other compressed gases must be reported to the chief controller of explosives (CCE), Nagpur immediately under the Gas Cylinder Rules of 1981. Accidents involving an explosive are required to be reported to the same authority under the Indian Explosives Act, 1884. Explosions or fires involving petroleum have to be reported to the CCE under the Petroleum Act, 1934. Owners of boilers are expected to report accidents within 24 hours under the Indian Boilers Act. Safety in transport of petroleum either by land or water is covered under the Petroleum Rules, 1976. But information about accidents is still extremely limited.

Agencies like the Labour Bureau, Indian Bureau of Mines and the Bureau of Police Research and Development are compiling and maintaining some statistics about chemical poisoning but these figures neither give an up-to-date picture nor very explicitly give the basic causes of accidents and the chemical substances involved. There is no common agency to collect or report accidents involving all kinds of chemicals.

There are a number of separate acts which deal with aspects of the chemical safety problem. But even when put together, they are totally inadequate to deal with the emerging safety problems, which arise at all stages of chemical manufacture, import, storage, transport and handling, and finally even at the point of sale and use in agriculture and industry and by the general consumer. For instance, the country does not have any legislation to prohibit the import of chemicals which are themselves banned in exporting countries. There are few controls on transport of hazardous substances and the few that exist deal with traditional substances like petroleum. Accidental discharge of toxic chemicals as happened in Bhopal, either during manufacture or transport, is not covered either and emergency planning to deal with such events is totally absent. The new Air and Water Pollution Control Acts are adequate only for conventional pollutants. They do not provide for the collection, treatment and disposal of toxic and hazardous wastes.

The number of institutions which have properly trained humanpower and adequate facilities to determine the safety of chemicals is only three: the National Institute of Occupational Health at Ahmedabad, the Industrial Toxicological Research Centre in Lucknow, and the Central Labour Institute in Bombay. In recent years, the government has set up a chain of five labour institutes across the country to deal with problems of chemical safety but they do not possess proper laboratories.

There is also a need for an urgent research programme to assess the health hazards posed by exposure to chemicals in the work and general environment and to set suitable limits for safety. Safety criteria must be established soon for all stages of import, production, storage and transport of toxic and hazardous substances. Health services also need to be organised and doctors trained to deal with chemical poisoning. Finally, but most important of all, the decision should be made when the license is given to prevent the production of toxic and hazardous substances, unless they are vital.

## Catastrophic Pollution

Incidents of catastrophic pollution leading to major ecological disasters are becoming increasingly common all over the world, causing deaths of hundreds of people every year, injuries to many more, and spending of hundreds of millions of dollars in their aftermath.

According to a paper prepared a few months before the Bhopal disaster by the Paris-based Organisation for Economic Cooperation and Development, a joint think tank of free market developed countries, there are a number of causes that can (even excluding nuclear) lead to major accidents and ecological disasters. These causes, together with some major incidents, are:

**Accidents with systems meant for storage and transport of energy:** a) Oil tanker accidents leading to massive oil spills: Each year from 1974 to 1983 there were between 5 and 37 tanker accidents (average: 19 a year) involving spills of over 675 tonnes. In the period 1974-1982, the number of times insurance companies have had to pay out over $0.25 million has averaged 17 a year. On seven occasions since 1974, the figure has been over $10 million. The two most disastrous accidents have been caused by the Amoco Cadiz and Tanio oil tanker wrecks off the coast of Brittany.

b) Explosions in oil and gas installations: The two latest disasters were in the Third World. In February, 1984, 500 people were killed in Sao Paulo, Brazil when a gasoline pipeline exploded and in November, 450 died (and 1000 still missing) in Mexico City when liquefied gas tanks exploded.

c) Bursting of oil storage tanks: Some 8500 tonnes of oil were spilled on a coastal area in Japan; clean-up costs amounted to $43.3 million and compensation another $56.7 million.

d) Bursting of dams: Worldwide, the probability of a dam bursting is between one to two cases a year involving death and devastation over large areas. Between 1918 and 1958, there were five such cases in the US leading to 1680 deaths. The biggest dam disaster recorded is that of Morvi in 1979 in India. Between 1970 and 1983, three major dam bursts each have been reported from Colombia, India and USA, and one each from Argentina, Mozambique, Nepal and Liberia.

**Damage to offshore oil installations leading to massive oil pollution:** Spectacular accidents have resulted in considerable expenditure. The most serious cases of pollution seem to be the ones at Santa Barbara in USA in 1969 and Funiwa in Nigeria. The biggest oil spill (0.5 million tonnes) resulted from the oil well, Ixtoc one off Mexico and polluted US coasts one thousand miles away.

**Damage due to build-up of dangerous toxic wastes at toxic waste disposal sites:** Present estimates suggest that the US will be paying more than US$ 16 billion over the next decade or so to clear some 2000 old toxic waste dumps. Some 2500 people had to be evacuated from Love Canal in USA and more than $40 million spent in 1978 because of cancer risks. At Lekkerkerk in Netherlands, $70 million had to be spent because of a disposal site that made it necessary to evacuate nearly 870 people. In West Germany, $ 2.2 billion will be needed to clean up some 2000 dumps.

**Progressive contamination of soil around industrial installations through disposal of toxic wastes:** In Morocco, 31 children died of lead poisoning due to waste from a lead works being dumped in the middle of a village. In Belgium, in the suburbs of Antwerp, it cost $20 million to get rid of lead-contaminated dust, which had settled in neighbouring houses poisoning children. In areas surrounding old aluminium works in France, Germany, Switzerland and Greece, soil contamination by fluorine effluents has caused serious livestock losses and obliged compensation to farmers. In Japan, toxic wastes from many old mines was left on the surface, and 3000 tonnes of arsenic wastes caused 140 cases of poisoning between 1920 and 1962. Compensation was received a few years ago.

**Accidental releases of chemicals and gases leading to serious air pollution:** Several toxic chemicals have been involved in major accidents: fluorine, lead, mercaptan, asbestos, hydrogen sulphide, certain pesticides, sulphur dioxide, hexavalent chromium, chlorine and ammonia. In 1950 in Poza Rice in Mexico, accidental discharge of hydrogen sulphide put 320 people in hospital and caused 22 deaths. In 1976, in Baton Rouge in USA, 10,000 people had to be moved out after an accident involving 90 tonnes of chlorine. In that same year, accidental release of dioxin in Seveso, Italy affected people in 18,000 hectares because of which 730 people had to be moved out and 0.25 million cubic metres of contaminated soil had to be buried. The Bhopal disaster is, of course, the biggest disaster caused by an accidental release of a chemical into the air. Pollution from several companies has also combined occasionally to create disastrous situations in adverse weather conditions. In 1947, in Donora, USA; 43 per cent of the population of 14,000 was affected and 20 died. In 1983, more than 85,000 Japanese were officially recognised as victims of air pollution and received compensation from industry by means of a tax on air pollutant emissions.

**A major explosion in an LPG storage plant recently shook Delhi. (Times of India)**

**Accidental (or occasionally even steady) releases of chemicals leading to serious water pollution:** Accidental spilling of 20 tonnes of acrolein into the Rhone in 1975 killed 300 tonnes of fish. Damages to Corsica resulting from the dumping of red mud into the Mediterranean by Montedison has not yet been assessed, 20 Italian fisherfolk have been compensated because of damage to fisheries. In 1975, excessive release of Kepone, a pesticide, into the James river and Chesapeake bay in Virginia, USA by a company caused serious damage. Dupont had to pay a fine to the State of Virginia for the mercury discharged by it into a river 30 years ago. In 1976, a ship carrying 250 tonnes of tetraethyl lead went down off the coast of Italy and the government had to spend French Francs 55 million to retrieve the drums. Toxic chemicals have had to be retrieved after ship wrecks off the coast of Sardinia and from the North Sea in other accidents. Water pollution has been most serious in Japan, the most famous case being of Minamata Bay. Between 1973 and 1983, the Japanese industry paid over $200 million in compensation to thousands of victims of water pollution—some $20 million a year on average—for substances mainly discharged between 1950 and 1970.

**Environmental damage caused by noise:** This problem arises in particular near airports and railway lines. After a 14-year trial, 3828 victims near Osaka airport received about $5 million in compensation.

Raghu Rai India Today

# THE BHOPAL DISASTER

Ashay Chitre, a film maker living in Bhopal's prestigious Bharat Bhawan, built by the state government to attract artists to this central Indian city, heard a commotion outside his window early in the morning at about 3 am. It was a chill December and all the windows of Chitre's house were closed. As Chitre and his wife Rohini, seven months pregnant, opened the window, they got a whiff of gas. They immediately felt breathless and their eyes and noses began to stream with a yellow fluid.

Sensing danger, the couple grabbed a bedsheet and ran out of the house. Unknown to them, all the neighbouring bungalows, which had telephones, had already been evacuated. Their immediate neighbour, state Labour Minister Shamsunder Patidar had fled. The chief minister, who lives only 300 m from the Chitres had probably also been informed in time.

Outside their house the Chitres found chaos. There was gas everywhere and people were running for their lives in every direction, with nobody to tell them the safe direction. Some fell down vomiting and died. The panic was so great that people left their children behind, or did not stop to pick up those overcome by exhaustion or the gas. At one place, the couple saw a family stop running and sit down; "we will die together", they said. Another person ran for 15 km in a desperate bid to escape. A passing police van had no clue to the safe direction. Stepping over dead bodies, the Chitres ran towards the local polytechnic, half a kilometre away, where they stopped and decided not to go further.

Two hours later, at about 5 am a police van arrived announcing that it was safe to go back home. But nobody believed the policemen. From the polytechnic, the Chitres rang friends on the other side of the town for help. They returned home three days later. Their pomegranate tree had turned yellow and the peepul tree black. Three days after that fateful night, Rohini began to experience pain whenever she exercised and Ashay felt his legs buckle. They immediately left for Bombay to see a neurologist to ascertain their fate and that of their unborn child.

### Mass panic

There were thousands of others that night in Bhopal for whom this macabre drama began much earlier and who were a lot less luckier than the Chitres. Most of them were the city's poor, living in the sprawling settlements opposite and around the Union Carbide factory. One of them is Ramnarayan Jadav, a driver of the city corporation, who says that he had started feeling the gas around 11.30 itself. But he stayed on for at least another 45 minutes because "this much gas used to leak every eighth day and we used to feel irritation in the chest and in the eyes. But finally everything used to calm down." Even if the company had set off its warning siren then, many could have escaped.

But nothing happened and many thousands woke up only between 12.30 and 1 am, by which time the gas was spreading in high concentrations. People woke up coughing violently and with eyes burning as if chilli powder had been flung into them. As the irritation grew and breathing became impossible, they fled, some with their families and many without. They got on to whatever they could—cycles, bullock carts, buses, cars, autorickshaws, tempos, trucks and mopeds. Scooters had whole families on them. Trucks were full but people hung on outside, some grabbing the legs and hands of those already inside. Small children, old men and women were pushed in handcarts or carried.

By 3 am the main thoroughfares were jammed with an unending and uncontrollable stream of humanity. The streets were foul with vomit. Those who fell were trampled by the crowd. The worst affected were the children: unable to walk and breathe, they simply suffocated and died.

Thousands fled to towns hundreds of kilometres away: Sehore, Vidisha, Hoshangabad, Raisen, Obaidullaganj, Ashta, Ujjain, Dewas, Indore, Ratlam and even Nagpur 400 km away. About 10,000 men, women and children reached Sehore between 2 am and 4 am. Another 10,000 went to Raisen. They flocked to the district hospitals for treatment. Hundreds of people who dashed to Ujjain and Indore had to be immediately hospitalised there. In the midst of this frenzy, there was no dearth of valour. Hundreds of taxi, autorickshaw, tempo and truck operators risked their lives to evacuate thousands of people.

The gas that spewed out of the high-tech factory of the multinational Union Carbide spread over some 40 sq km and affected people seriously as distant as 5 km to 8 km downwind. For nearly 200,000 people, a quarter of the city's population, Bhopal became a gas chamber. If it were not for the two lakes of Bhopal which came in the way of the gas cloud and neutralised it, an even bigger tragedy could have

### Carbide's Lies

The response of Union Carbide to the happening of that ghastly night was lies. As victims crowded into the Hamidia Hospital, L.D. Loya, the company's medical officer, told the frantic doctors: "The gas is non-poisonous. There is nothing to do except to ask the patients to put a wet towel over their eyes."

This was not Union Carbide's only lie. At about 1 am, city Superintendent of Police Swaraj Puri was woken up by a town inspector telling him that people in Chola, a settlement about 2 km from the plant, were fleeing because of a gas leak. Puri rushed to the police control room by 1.25 am only to find the duty staff coughing violently and rubbing their eyes. Between 1.25 am and 2.10 am he called the plant three times; twice he was told: "Everything is OK". The third time: "We don't know what has happened, sir", before the phone was banged down.

At about 1.45 am—45 minutes after the leak was confirmed—the additional district magistrate got through to J. Mukund, the works manager, at home. Mukund was not even aware of the gas escape and replied: "The gas leak just can't be from my plant. The plant is shut down. Our technology just can't go wrong. We just can't have such leaks."

At no point during that night did Union Carbide itself try to reach the authorities with information about the leak or tell them what to do. At about 3 am Union Carbide did send a man, a retired major who works with a private security outfit employed by the company, with the message that the leak had been plugged, a blatant lie as no plugging ever took place, the gas had simply stopped oozing. But Mukund again told a reporter the next morning that the leak had been plugged within minutes of his being informed.

In fact, even 15 days after the disaster and thousands dead, Mukund was still defending his statement: MIC is only an irritant, it is not fatal: "It depends on how one looks at it. In its effects, it is like tear gas, your eyes start watering. You apply water and you get relief. What I say about fatalities is that we don't know of any fatalities either in our plant or in other Carbide plants due to MIC," said Mukund.

## That Fateful Night

Exactly what happened in the Union Carbide factory that night is still not known officially from the Government of India. But press reports have built up the following sequence of events.

MIC is stored in three double-walled, partly buried stainless steel tanks—code named 610, 611 and 619. While thousands slept in their huts around the pesticide factory on the night of December 2/3, a skeleton staff of 120 workers inside the factory ended its evening shift around 10.45 pm and a new shift took over around 11 pm. One of the workers then noticed that the pressure in tank 610—the tank from which all the MIC finally escaped—had risen from the 2 lb per square inch (psi), recorded by the earlier shift, to around 10 psi. Corresponding tank temperatures were not available as they were not logged normally. The five-fold increase in pressure within an hour was dismissed in the belief that the pressure recording instrument could be faulty. Shakil Qureshi, the supervisor on duty, said later, "Instruments often didn't work. They got corroded. Crystals would form on them."

About 11.30 pm, workers in the plant realised there was an MIC leak somewhere: their eyes began to tear. A few of them walked around the MIC structure and spotted a drip of liquid about 50 feet off the ground and some yellowish-white gas accompanying the drip. They told Qureshi about the leak at about 11.45 pm. Qureshi, however, decided to deal with the leak after the tea break, scheduled for 12.15 am. Qureshi says he was told only of a water leak. But by the time the tea break ended at 12.40 am, events were moving very fast.

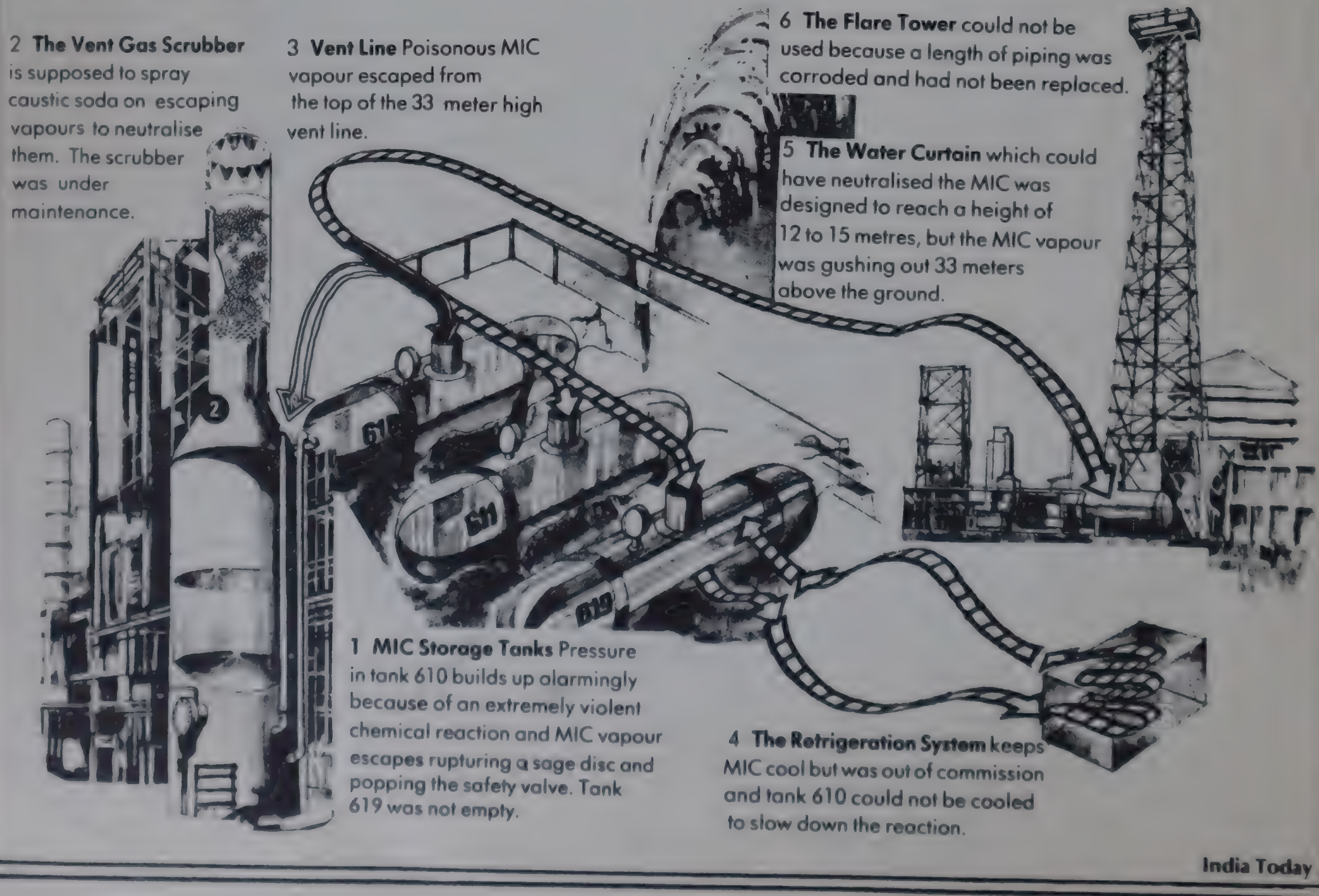
Suman Dey, a worker at the plant noticed, that the temperature gauge on tank 610 had reached 25°C, the top of its scale, and pressure was rapidly moving towards 40 psi, the point at which the emergency relief valve opens. He rushed to the storage tanks to investigate and was horrified. As he stood on a concrete slab above the storage tanks, the slab suddenly began to shake. "There was a tremendous sound, a messy boiling sound, underneath the slab, like a cauldron." He ran, only to hear a loud noise behind him. The slab made of 60 feet of concrete, at least 6 inches thick, was cracking. The heat was like a blast furnace. He couldn't get within six feet of it. He then heard a loud hissing sound and saw gas shoot out of a tall stack connected to the tank and form a white cloud drifting over the plant and towards the sleeping neighbourhood. In the plant, he found that the pressure indicator had gone above 55 psi, the top of the scale, and the safety valve had opened releasing MIC from the storage tank.

As the workers realised it was a massive MIC leak, Qureshi ordered all water sources in the area shut off. Over three hours before, a supervisor who had arrived only two months before from a Calcutta battery factory owned by Carbide, had asked a novice operator to clean a pipe. The supervisor told him to open a nozzle on the pipes and put a water hose in to clean the inside. The pipe took filtered MIC to the storage tanks. It had a valve that had been closed. The slip blind which ought to have been inserted to make sure the water did not leak through the valve, was missing. Valves in the plant were notorious for leaking. Qureshi claimed there were no instruments either to check leaky valves.

As Qureshi realised the enormity of the leak, he asked for water to be sprayed on the leak. But nothing seemed to work. The water jet failed to reach the top of the 120 feet stack from which MIC was escaping. Suman Dey then rushed to turn on the vent gas scrubber to neutralise the escaping gas. The scrubber had been under maintenance and had been removed from an "operating mode to a standby mode". The flow meter did not indicate that the circulation of caustic soda—the neutralising agent—had started. No one also knew of the caustic soda concentration because no analysis had been made since October.

The factory has two sirens: a loud, continuous one for the public and a muted one meant for factory workers alone. The public siren was put on around 1 am, nearly an hour after the gas had started escaping, but it was put on only for a few

### The System that Failed



2 **The Vent Gas Scrubber** is supposed to spray caustic soda on escaping vapours to neutralise them. The scrubber was under maintenance.

3 **Vent Line** Poisonous MIC vapour escaped from the top of the 33 meter high vent line.

6 **The Flare Tower** could not be used because a length of piping was corroded and had not been replaced.

5 **The Water Curtain** which could have neutralised the MIC was designed to reach a height of 12 to 15 metres, but the MIC vapour was gushing out 33 meters above the ground.

1 **MIC Storage Tanks** Pressure in tank 610 builds up alarmingly because of an extremely violent chemical reaction and MIC vapour escapes rupturing a sage disc and popping the safety valve. Tank 619 was not empty.

4 **The Refrigeration System** keeps MIC cool but was out of commission and tank 610 could not be cooled to slow down the reaction.

**India Today**

minutes, when the muted siren took over. This followed the company's procedure which was evolved to avoid alarming the public around the factory over tiny leaks.

Most residents around the factory woke up not because of the siren but because of the irritation caused by the gas. Meanwhile, an announcement was made over the factory's public address system about the wind direction and the workers fled opposite to it. This saved them all except Qureshi who fell, broke some bones, inhaled the gas, and was for long in hospital. The public siren came back on at 3.00 am, after the works manager arrived, but by then there was no need to tell anybody: hundreds were already dead and many were destined to die over the next few hours and days.

UCC's report on the incident claims that tank 610 had 90,000 pounds of MIC at the time of the incident. For approximately two hours, the safety valve remained open releasing over 50,000 pounds of MIC in vapour and liquid form—and goodness alone knows what other gases: phosgene, hydrogen cyanide, carbon dioxide, all of which have been mentioned. Sometime between 1.30 am and 2.30 am the safety valve reseated, as the tank pressure went below 40 psi.

**Safety devices**

The plant has two main safety devices. The first is a scrubber, which neutralises the gas with caustic soda. If the scrubber fails, the gas goes to the flare tower to be burnt off. Both the safety systems failed to work that night. For days, newspapers reported guesses about why the safety systems did not work.

On December 7 the first real bit of news appeared. Leaders of the factory's employees' union claimed that the vent gas scrubber had been under repair. About 10 days later, the factory's Works Manager J. Mukund publicly contradicted this report but was unable to answer how he knew the vent scrubber had worked. UCC has since claimed that the used caustic soda tank was hot to touch (60°C) on the morning of December 3, indicating that it must have worked. But it is now also widely accepted that the scrubber was grossly underdesigned and could not have neutralised more than a fraction of escaping gases.

The flare did not work because the management had disconnected the pipeline running from the vent scrubber to the flare tower for maintenance and connected it to a vent gas pipe which went straight to the atmosphere. Even the flame on the flare tower had been shut off. Thus, all the plant's safety defences were down.

There were three other safety systems that were either not used that night or proved to be underdesigned. First, the factory has a network of water jets. But they could not reach the height at which the MIC was gushing into the air. Second, the MIC storage tanks are connected to a 30-tonne refrigeration system which keeps the liquid MIC at 0°C. The refrigeration system had been closed down in June 1984, and the gas was at 15°-20°C. Had the refrigeration system been working or capable of working, the MIC could have been cooled. Refrigeration would have increased the time available for the detection of the chemical reaction and safe disposal of the material before the reaction reached a dangerous speed. Third, the Bhopal plant had three tanks, each with a 60-tonne capacity, one of which was to be always kept empty for contingencies. But all the tanks contained MIC that night.

**Violent reaction**

But what caused the violent reaction that night? Union Carbide's scientists have been aware of the possibility of an explosive 'runaway reaction' in MIC. This gas can react with almost any chemical, including itself, to generate substantial quantities of heat and carbon dioxide. The heat released causes the reaction to speed up, which generates more heat, and pressure can thus go on building up till it finally reaches an explosive level. The longer the MIC sits in storage tanks, the greater the chance of side-reactions building up to a runaway reaction. The MIC at the Bhopal plant had been sitting in the storage tank since October. Demand for carbaryl was not very high.

**The killer tank 610. (Bedi/Times of India)**

The precise sequence of events still remains obscure. Carbide's report has claimed that it was an unique combination of large amounts of water (120 to 240 gallons), higher than normal amounts of chloroform in the stored MIC (several per cent instead of a maximum of 0.5 per cent), and an iron catalyst, that lead to the violent reaction in MIC, stored at a higher than specified temperature. The heat released by the reaction between the water and MIC raised the temperature in the tank. Simultaneously, MIC got polymerised, the reaction being catalysed by iron resulting from the corrosion of the tank walls due to the high temperatures. Carbide claims that the corrosion rate increased markedly because of the presence of an abnormally high level of chloroform. The rapid release of carbon dioxide in large quantities then helped to build up high pressures, which forced the foaming mass of chemicals out of the tank.

Several Indian experts are not convinced of Carbide's explanation. The quantity of iron needed for the explosive reaction could not have come from the corrosion of the stainless steel tank. Carbide claims that the reaction lasted only three-and-a-half hours. Indian experts, therefore, argue that iron must have been already mixed with the water that seeped into the tank. UCC, in its drive for cost cutting, had used pipes and valves made of inexpensive carbon steel instead of stainless steel, against its own safety rules. Thus, the iron must have come from the piplelines and not the tank.

Dr S. Varadarajan, who lead the investigations on behalf of the government, has expounded another hypothesis. Small quantities of water—probably as little as two to three litres—could have reacted with phosgene in the tank, mixed with MIC as an impurity to keep it stable. The phosgene-water reaction produced heat, carbon dioxide and hydrochloric acid. The heat and hydrochloric acid acted as the accelerators of the polymerisation of MIC leading to a runway reaction. The reaction could have started even two weeks before the fatal night, steadily building up imperceptibly to anyone.

Speaking at the Indian Science Congress in January 1985, Varadarajan claimed that his team had not found anyone in Bhopal who had any idea of the chemistry of MIC. Engineers at the plant went by operating manuals only and did not know the plant design. Efforts to locate the original designers of the factory to learn more about the system had also failed. There is still an absence of hard evidence to confirm exactly what happened. No reliable records exist of a number of parameters involved. The examination of the contents of the tank, particularly the quantity of polymer available in the tank, may help to reach some conclusions.

But even more difficult was the task of the journalists, who were trying to construct a picture of what happened that night for an overawed public. As one reporter but it, "there was virtually a total clampdown on any kind of information flow on the technical side of the matter. Government officials refused to talk. Only Dr Varadarajan was empowered to talk. Dr Varadarajan himself was not accessible." The Varadarajan report has not yet been made public.

taken place.

The railway station lay close to the factory and smack in the path of the gas cloud. It carried off passengers in waiting rooms, porters and conscientious railway staff who stayed on. Rehman Patel, the deputy chief power controller, risked his life by staying. When Patel's chief came in response to frantic calls, he found him still at work, while his wife and 14-year-old son had already died in the neighbouring railway colony. The control room which monitors movements of all trains on this vital trunk route, was, however, in a mess: vomit and human excreta scattered all around, files and registers in disorder, chairs knocked down.

After midnight, the 116 Up Gorakhpur-Bombay Express rolled in but its passengers miraculously escaped death, presumably because they kept their windows closed because of the cold night but also because Station Superintendent H.S. Bhurvey risked his life to wave the train on to safety. Bhurvey, who was found dead later, also alerted all the nearby stations to stop trains from coming into Bhopal. For more than seven hours, this major station remained cut off from the rest of the world. Next morning, hundreds of sick and writhing people were found all around, on platforms, on staircases, in the office rooms and even on the railway tracks. On the road and footpaths around the station were the bodies of poor beggars and urchins.

Those who could not flee made their way to the hospitals. At Bhopal's 1,200 bed Hamidia Hospital, the first patient with eye trouble reported at 1.15 am. Within five minutes, there were a thousand and by 2.30 am there were 4,000, suffering from not just eye ailments but also from respiratory problems. The hospital staff's first response was of shock and bewilderment. Nobody knew what to do and Union Carbide was not volunteering any useful information. Several staff members at Hamidia, about 3 km from the factory, were soon overwhelmed by the gas themselves. They had to be replaced by a fresh medical team. Journalists visiting the hospial at 2.30 am saw only one doctor, and he he had no medicine to treat patients with. Till early morning, in fact, there were hardly any doctors and medical students from nearby hostels were filling in. Victims were still being brought in army trucks to the hospitals. In front of hundreds of silent, helpless spectators, people and especially small children were breathing their last. Even when the treatment began in earnest it was only for token relief: application of an eye ointment or an injection to ease the spasms caused by the constriction of the trachea.

By the time the sun rose, hundreds, some even say thousands, lay dead, many on the roads and many at home under their tattered quilts: corpses with distended bellies were beginning to rot, attracting vultures and dogs. Another 2000 lay dying in hospitals and homes. An equally hideous sight was that of the carcasses of hundreds of dead cattle and animals all over the gas-affected area, swollen up to size of elephants.

By about 1 am, about 25,000 people were crammed into Hamidia Hospital. The floor was splattered with blood and vomit. Said a doctor at Hamidia: "I was standing in the pediatric department. There was such a terrible crowd, that there wasn't even place to keep bodies on the floor. As soon as a patient was declared dead, his relatives would just vanish with the body. I saw at least 50 bodies taken away like this. I would estimate that anything between 500 and 1,000 bodies were taken away before their deaths could be registered." It was difficult for survivors to identify their dead. It was difficult even to distinguish between dead and half-dead bodies. People at the mortuary were unable to cope and conduct post-mortems. One father cried: "They have taken away my son. He was only three years old. My father, mother and two children are in a serious condition. May Allah punish those scoundrels."

### Dead administration

While the administration slumbered, the army moved in. The sub-area commander, Brigadier N.K. Maini, had been called by retired Brigadier M.L. Garg, general manager of Straw Products, a factory which lay in the path of the gas cloud at about 1.15 am. Garg, who had been told by workers at his factory that they were suffocating, needed help to evacuate some 176 people. He immediately approached the army and got help: several cars and closed trucks. Straw Products workers were evacuated to the military hospitals but not before some were dead and others seriously ill.

By 2.45 am the army had sent a fleet of vehicles and started a systematic search of houses for people trapped within. Major G.S. Khanuja of the Electrical and Mechanical Engineers Centre made repeated trips to the factory area setting up a continuous evacuation channel to the Military Hospital as well as the Hamidia Hospital all through the night. Khanuja went house to house looking for victims. The city's Superintendent of Police Swaraj Puri, who joined the army in this search later told a reporter, "It was awful. Knock on any door and all you found were bodies." Khanuja was finally hospitalised himself. As Praful Bidwai of 'The Times of India' put if "If there was a wretchedly undignified, hideously helpless form of megadeath after Hiroshima and Nagasaki, this is it."

At the Hindu cremation grounds, about 15 pyres were lit at a time, starting at 9 am. The crematoriums soon ran out of firewood and trucks had to be marshalled to bring in more. To save time, money, energy and humanpower, five to 10 persons were cremated on each pyre. As per Hindu rites, the children and infants were buried at breakneck speed by a group of gravediggers. Few parents were seen around.

At the Muslim burial ground, too, there was not enough space to bury the bodies coming in. Rescue workers dug graves each holding 11 bodies. When there was no more space left, old tombs were opened and 100-year old bones displaced to make room. The head priest of the Muslim clergy in Bhopal had to issue a 'fatwa' to allow the digging up of old graves. Packs of dogs prowled around and if they found a grave not deep enough, they would haul out bodies and devour them.

### Death drama

The death drama continued for days. Thousands continued to pour into the hospitals of Bhopal, as some 500 doctors and supporting staff rushed in from other cities of Madhya Pradesh. This is how a foreign correspondent, who reached the city 30 hours after the leak, described the state of gas-affected Bhopal: "At the factory, dead bodies were still on the ground, being picked up and loaded aboard a waiting truck. Everywhere one turned, people were retching,

## The Death Toll

Exactly how many died in the Bhopal disaster remains a mystery. On the first day, the government counted 400 dead and unofficial sources said 500. The second day, the gap widened. The government figures rose to 550 while unofficial figures jumped to 1,200. The third day saw another 400 deaths at city hospitals. The unofficial figures, thus, rose to 1,600 but the government gave out only 620—583 dead in Bhopal and 37 in other cities. On the fourth day, as unofficial figures went up to 1,700, the government doubled its earlier death estimates to 1,327. The Chief Minister, Arjun Singh, claimed there was no effort to hush-up the number of deaths. Information was yet to arrive from affected villages.

But from the fifth day, the gap between official and unofficial deaths increased again. By the end of January 1985, the government was counting 1,430 dead while newspapers all over the world and in India were quoting the unofficial figure of about 2,500. The Indian Council of Medical Research has since claimed that most of the deaths occurred in the first 48-72 hours, about 1200 died in hospital wards and the total death figure was probably 2000. In its petition in the US courts, the government has claimed 1700 dead.

But there are many who believe that even the unofficial estimates are not anywhere near the truth. Members of the Zahreeli Gas Kand Sangharsh Morcha have claimed that corpses were picked up by the army in hundreds and trucked away to be buried and cremated en masse. In those first two horrendous days, few were interested in counting bodies. The Morcha has claimed that the number of dead must have been over 5,000.

A UNICEF official who returned to New Delhi after a week-long visit to Bhopal pointed out in his confidential report in December that the death toll may have been as high as 10,000 and that many government officials and doctors privately believed this figure to be true. The local Cloth Merchants' Association had claimed that retailers had sold or distributed cloth for over 10,000 corpses. UNICEF estimated that affected people were about 200,000, of which 80 per cent were Muslims, 75 per cent slum dwellers, 40 per cent children below 15, 20 per cent women in the reproductive age group, and 10 per cent elderly women.

The result of the door-to-door survey conducted by the Bombay-based Tata Institute of Social Studies and other schools of social work have failed to gain any credibility. The survey was commissioned with great fanfare by the state government and its results were to become the basis for relief, compensation and long-term treatment. But its total tally of 1021 dead, even less than the officially counted bodies, has been a subject of much derision.

The survey failed to cover 600 families in which multiple deaths could have occurred. It could not enumerate 315 families in the worst affected areas who had migrated to other cities after the disaster, and another 286 families whose houses were locked. The survey also failed to cover over 3000 people who were shelterless in the city. Many beggars and pavement dwellers who lived around the railway station had died in the gas tragedy. The government does not as yet have an authentic list of the victims.

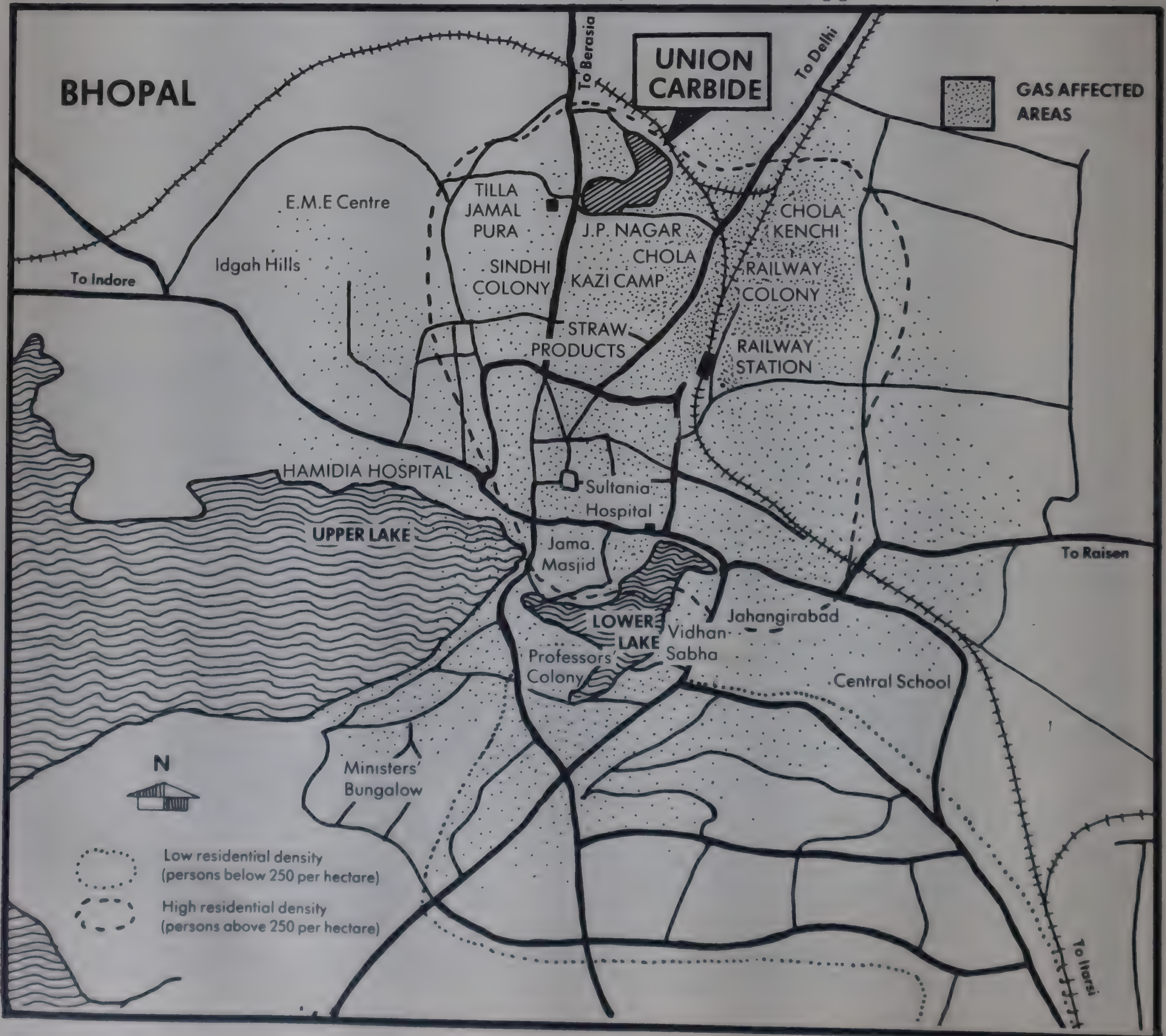
The Centre for Social Medicine and Community Health of the Jawaharlal Nehru University in New Delhi has also conducted a survey in which one out of every 15 household living in the most adversely and moderately affected 29 bastis, with a total population of about 68,000, were enumerated. The survey actually found 82 dead and five missing people in 65 households—one death each in 49 households, two deaths each in 11 households, three deaths each in four households and four deaths in one household—which gives a total death rate of 1305 in the 29 bastis surveyed.

The study found that those who died were the poorest. More than half the affected people belonged to an income group—about Rs 150 per head per month—which cannot afford two full meals a day around the year. Those who died were even more disadvantaged than the overall affected population. The patched up planks, pieces of tin, plastic sheets and thatch which formed the walls and roofs of their hutments, left gaping holes for the gas to come into their grossly overcrowded single 'rooms'. Seventy four per cent ran on foot after hearing of the poisonous gas, six per cent on a vehicle (motorised or bicycle), and 21 per cent decided to stay. None of those who went on a vehicle died. Three quarters of the deaths were amongst those who ran on foot and one quarter amongst those who stayed. The relatively affluent got better protection in their better built houses.

**The government still does not know how many died. But they were invariably the poorest of the poor.** (Ashok Chaddha) racked by violent coughing. All the shops in the city were closed, and on every street people were lying in the gutters. They were dead, humped in agonised frozen postures, like birds shot from the sky. In their midst were real birds, vultures. When the vultures swooped away, the dogs would charge in and tear off pieces of flesh. Rescuing the dead from the predators were rifle-toting soldiers of the Indian army, joined by volunteer vigilantes carrying long staves. Little children with haunted, running, swollen eyes told of scampering through the night, with no particular destination. They asked the soldiers where they could find their parents. The soldiers replied, 'Wait here. A truck will be along and take you to the hospital. Everyone will be there.' The frightened children waited. When the truck came, it took the children to Hamidia Hospital. The army was there too, keeping the human traffic flowing without the usual pushing and shoving. The troops had set up 60 tents, which became instant wards for 20 people each. Some distance away, the army had set up a morgue to which the patrols in the city brought the dead to be identified. 'I thought I had seen everything,' said Subedar A.B. Bhosale, 'but this is worse than war!"

The third day saw another 400 deaths at the city's hospitals, which said that 75,000 people had been treated by then. Fresh cases of MIC poisoning continued to arrive, raising fears of after-effects. Some victims showed signs of paralysis, 500 developed corneal ulcers and doctors said that they could go blind. At the burial ground, people helping to dig graves were exhausted. "We are sick of burying the bodies. There is no space," they said.

On the sixth day there was yet another scare. Some 51 fresh cases who had earlier been sent home after being treated for minor eye ailments had to be rushed to the hospitals in a serious condition. Doctors believed that these people may have been affected by the fish eaten from the Bhopal lake. The main fish market of the city was immediately sealed off by the authorities as a precautionary measure. The next day the government announced that slaughter houses were being closed down so that the meat of gas-affected animals could not be sold but there was no ban on the sale of fish. On the seventh day a fresh panic over the disposal of the remaining gas struck the city.


BHOPAL
To Berasia
UNION CARBIDE
To Delhi
GAS AFFECTED AREAS
E.M.E Centre
TILLA JAMAL PURA
J.P. NAGAR
CHOLA KENCHI
Idgah Hills
SINDHI COLONY
CHOLA KAZI CAMP
RAILWAY COLONY
To Indore
STRAW PRODUCTS
RAILWAY STATION
HAMIDIA HOSPITAL
Sultania Hospital
UPPER LAKE
Jama Masjid
To Raisen
LOWER LAKE
Vidhan Sabha
Jahangirabad
Professors' Colony
Central School
N
Ministers' Bungalow
Low residential density (persons below 250 per hectare)
High residential density (persons above 250 per hectare)
To Itarsi

**Many believe that the exodus from Bhopal was deliberately engineered by a state government anxious to diffuse growing public anger.**

## The neutralisation drama

Even as hospital admissions and deaths began to show a steady downward trend, the seventh day after the disaster brought a new source of panic to the city: there were still 15 tonnes of the deadly gas left in the factory, which had to be disposed off before Bhopal could really feel safe.

The government entrusted the task of deciding the disposal process to a team of senior scientists headed by Dr S. Varadarajan, director-general of the Council of Scientific and Industrial Research (CSIR). Varadarajan set up his office in the Central government's Regional Research Laboratory at Bhopal and shrouded himself in complete secrecy, nerve-wracking for the rest of the city. Journalists were told that there were four ways of disposing off the gas: neutralise it with a chemical like caustic soda (as is expected to happen in the factory's vent scrubber), incinerate it (as is expected to happen in the factory's flare tower), pack it into drums and ship it off to the parent Union Carbide in the US or elsewhere, or simply start up the factory and turn it into the factory's final product, the pesticide carbaryl.

It was obvious that the company was pushing hard for the last option. Union Carbide Corporation of the US had immediately recommended to its units across the world: use up the remaining MIC to produce carbaryl before governments move in to stop those plants. The local Union Carbide management had reportedly tried to reopen the plant on December 7 itself, just four days after the tragedy, to dispose off the remaining gas. But the staff which reported for duty was turned back by the district administration in control of the plant.

Starting the plant again would mean that the chief minister who had piously declared on the fourth day of the disaster that the plant would never be allowed to open again, would have to eat his words. 'The Times of India' pointed out angrily, this would amount to a "form of capitulation to the company responsible for the death of over 1,300 persons .... It would be tantamount to granting Union Carbide some sort of safety approval or certificate and to letting its management, with its all-too-visible safety record, run the plant as it likes."

Word spread on December 10 that the factory had started up again, with one district official claiming that the work to "neutralise the gas had begun" by converting the deadly gas into finished products, but this was immediately denied in a press statement by Varadarajan. The city meanwhile waited tensely. The next day, amid reports that Varadarajan's team had restarted the plant for a test run, Arjun Singh appealed to the people: "There is no cause for panic and I repeat there is no reason to evacuate the city." But even as the chief minister was saying that there was no reason to evacuate the city, he and his government were acting differently. Government vehicles went around the city announcing to a surprised public that all schools and colleges were being immediately closed for 12 days from the next day. The Madhya Pradesh State Road Transport Corporation admitted to journalists that a large number of buses had been summoned to Bhopal from other parts of the state but clarified that this had been done only to cater to the extraordinary rush of people "returning to Bhopal"! 'The Times of India' could not even get official confirmation of the decision to get buses.

The people obviously saw in all this a government plan for emergency evacuation while the chief minister gave them false assurances. The government got police vans to go around the city to assure people that there was no danger. A similar assurance was broadcast over the local station of All India Radio. But all this had very little effect.

**Zero-risk method**

By the next day, the suspense was over. The government had decided to give in to the company. The chief minister announced that the government team had concluded that starting the factory was the "most practical and safe way" among all other options for disposal of the gas. This was the "zero-risk" method that he had earlier talked about. He said that the factory would start again from December 16 for four to five days to convert the remaining gas into carbaryl but all safety measures would be adopted and the 'neutralisation' process would pose no threat of any kind. He also proclaimed that he would be personally present in the plant throughout the neutralisation process. But to the people, already in a state of panic, all this meant little. Their worst fears were confirmed when they saw the government's 'two minds' policy continue. The chief minister in the same breath announced that his government was ready to evacuate up to 125,000 people from 13 vulnerable localities to refugee camps, if they wanted to leave, and additional buses would be available for those who wanted to go to friends and relatives in neighbouring towns. A separate camp would also be set up for people's animals.

The people displayed little faith in government pronouncements and decided to vote with their feet. The trickle which began on the day of the chief minister's announcement became a flood the next day. By the evening of December 13, over 100,000 people had left the city in an unprecedented peacetime exodus. The bus terminus was crowded the whole night and the authorities called up hundreds of extra buses. People travelled on rooftops of crowded buses and trains leaving Bhopal. Many transported their animals to neighbouring villages. Asked why they were leaving the town when the chief minister had declared that there was no danger, almost everyone said, "we do not want to die."

Said a PTI report: "The only people left behind (in the 13 localities identified by the chief minister as the sensitive areas) are either those with their own vehicles or those too poor to afford even a ride to safety. The spontaneous migration is unbelievable but true, defying logic or reason. It's like being driven by the fear of the unknown, a fever spreading like contagion. When told Chief Minister Arjun Singh himself would be present at the pesticide plant during the operation, they quipped, 'men like him can fly away. How about us?'."

The next day was no different and the exodus continued. The panic gripped the populace to such an extent that a large number of even those receiving medical treatment at several hospitals left their beds. By the evening of December 14, nearly a quarter of the city's population had fled.

Even the government's camps did not generate much confidence. Only a measly number of 4,800 people reached them. But here too they were as terrified as they were in the slums. The Indore daily 'Nai Duniya' reported: "If they had money, families, friends and relatives they too would have

### The Killer Company

Union Carbide is the third largest chemical company and 37th largest industrial corporation in the US. It owns 700 chemical plants, mines, mills and other business operations in 37 countries. Like the other big chemical corporations, it has been going through a rough time in the last few years as the world market for chemical goods has fallen. As the world's largest producer of ethylene glycol, a major building block in plastics production, Carbide has been seriously affected by its overproduction. Its annual sales at $9 billion were the same in 1983 as they had been in 1979, with less value in real money terms.

Carbide's operations are extremely diverse. It has been in the nuclear weapons game since the Manhattan Project of World War II, and is the sole contractor manufacturing enriched uranium and weapons components for the US government. It has uranium mines in Colorado and Wyoming and vanadium and chromium mines in South Africa and Namibia. It also makes consumer products like Eveready batteries—it is the world's largest producer of batteries—industrial gases, and molecular sieves for removing organic chemical pollutants from wastewater streams. Pesticides production is only a relatively small part of Carbide's operations and not the most profitable. Sales of agricultural products declined in 1983. Carbamate pesticides, manufactured from MIC, account for most of Carbide's agricultural products.

All of Carbide's operations have the potential of risk to health of workers and communities, and to the environment. When the tragedy at Bhopal happened, Carbide tried to picture it as a freak accident that has happened to a company with an otherwise exemplary record in environmental and health matters. But this is not only untrue, Carbide has consistently fought any claims of damages caused by its operations. Vinyl chloride workers, for example, at Carbide's South Charleston plant, were found in 1976 to have not only six cases of angiosarcoma, of the 63 found worldwide— a rare cancer associated with vinyl chloride —but also four times the expected rate of leukemia and twice the expected rate of brain cancer. Yet three years later, one of the Carbide's medical directors said, "to my knowledge there is no evidence on the face of the earth to link incidence of brain tumours to vinyl chloride." In 1982, Carbide faced some $ 15-20 million in worker compensation claims. The company was fighting them in the courts.

A Union Carbide subsidiary was also responsible for the Gauley Bridge tunnel disaster in the early 1930's, regarded as

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**Carbide's double standards: In Institute (USA), it informed neighbours about the dangers but never in Bhopal (Hindustan Times)**

one of the world's worst industrial disasters.Construction of the tunnel began in 1930. Tests showed that the rock was almost pure silica, a mineral known to cause silicosis. Instead of revising plans for tunnel construction Carbide decided to expand its size and to use the silica at a steel-making subsidiary. Unemployed coal miners in West Virginia knew enough about mining and quickly left. So the company recruited black workers from other southeastern states, who were forced to take any job, because of the Depression. Gauley Bridge tunnel workers began dying nine to eighteen months after exposure to the dust. The company avoided autopsies and death certificates. A US official has put the total at 476 dead and 1,500 disabled. The callousness which killed these workers has seldom been equalled in corporate history.

Union Carbide possesses four plants in Tennessee and Kentucky which manufacture nuclear weapons components, enrich uranium, and carry out scientific research in nuclear weaponry. Three of these plants were built in the 1940's in Oak Ridge, Tennessee. During the Second World War, Carbide operated part of the Manhattan Project in Tonawanda, New York. In both facilities, information has only recently surfaced about the environmental and health legacies the company's operations have left behind.

In the 1950's and early 60's, processes were being developed to use mercury for the separation of lithium-3, a vital component of the hydrogen bomb. One third or more of the known mercury in the world was bought up for Oak Ridge at this period. Carbide took no notice of the advice of electrochemists on how to work with and contain the mercury. A huge quantity of it was lost: 2.4 million pounds is unaccounted for. Some 475,000 pounds is known to have been spilled into a creek.

In 1983, Union Carbide's secrecy cover in Oak Ridge was blown. Mercury at levels 35 times greater than allowed by the state was found in soil. All the contaminated soil had to be excavated and removed, and a long, costly clean-up began. Shortly afterwards, Union Carbide announced that it would not seek renewal of its contract to operate the Oak Ridge facilities.

Union Carbide has also had many problems with its major pesticide, Temik. Pure aldicarb is probably the most toxic pesticide manufactured today but it is claimed that it breaks down very rapidly. Because it is so acutely toxic, studies have focussed on high level, short-term effects, and no systematic study has been made of long-term effects of low doses. The best documented human poisoning case is that of a nursery worker in Florida, who spent one Friday spraying Temik in a greenhouse, and was found dead in his apartment the following Monday. There have been other cases of lesser, but still severe, Temik poisoning among farmworkers.

By 1983, Temik was being used in 38 states, and exported to 60 nations. But events in the early 1980's began to refute the assumption that Temik could not prove a human health hazard because of its rapid breakdown. Temik had been widely used in New York potato fields, under Carbide assurances that it could not migrate into groundwater. In 1979, 1,500 wells were found to be contaminated with Temik, at levels above the state's safe limit for drinking water of 7 ppb.

Just when Carbide was striving to reassure people that Temik had only migrated into groundwater in Long Island because of some unique features of the island's topography and geology, it was found in groundwater around Florida citrus groves. Carbide has refused to release to the public its own information about Temik's health effects, claiming it is a trade secret. Other states—Wisconsin, Maine and North Carolina—have also discovered Temik in groundwater.

The problems with Temik demonstrate a major problem with toxic chemical regulation: although some testing of chemicals takes place before they are marketed, there are still many instances of new impacts on the environment or human health being discovered only after the chemical has become widespread. Union Carbide's chemicals are associated with this pattern.

Union Carbide has been particularly lax about health and environmental safety in the Third World. Union Carbide has been operating several plants in Puerto Rico since 1959. Neighbours of at least one of Carbide's operations have been complaining about the ill effects of air pollution created by the plant. In Yabucoa Carbide manufactures graphite electrodes for the steel industry. Graphite and coke dust, hydrogen sulfide and coal tar gases are emitted into the atmosphere. These materials can damage lungs as well as eyes and skin, and may even lead to cancer. In 1978, the government issued Carbide a show cause notice why it should not be fined for air pollution violations. It was not until 10 hearings later, that the government fined Carbide, the largest fine it had ever levied on any company. Although the company agreed to pay the fine, the problems have not stopped. Air pollution has continued, and Carbide has launched a much-publicised 'ecology' campaign in schools, educating children in the need for clean air and water.

In 1981, Carbide's Jakarta factory making Eveready batteries hit the headlines for personnel and worker-health practices that would never be condoned in the United States. In 1978 a worker was killed by electrical shock as he stood in water, immersed in a haze of carbon dust, having worked three consecutive days overtime. The new health officer became so distressed with company policy that she resigned in 1979. She found kidney disease and respiratory disorders among workers, excessive heat in working conditions, and mercury in well water supplying drinking water to the workers, and leaching into groundwater under neighbouring rice fields. In 1980, a new and bizarre health problem was added to those already being experienced at the Carbide plant: inspectors on the battery inspection line began to develop behavioral problems, and six had to be removed from their jobs.

gone far away from this ill-fated city. It is mostly beggars who have taken refuge in these camps." The authorities had to close down two empty camps.

**Safety systems**

Regardless of what people thought, the government team began preparations for ensuring extra safety during the disposal process. Experts finally came up with, as they described it to eager newspaper reporters, a six-step safety system. The first step was, in fact, no safety system: it was simply the process by which the pesticide carbaryl is produced by reacting the deadly gas with alphanaphthol. The second was the standard vent scrubber in the factory that had earlier failed to work. The only addition to this system was a set of fire hoses kept on two sides of the scrubber to keep it cool, in case too much gas came into the scrubber and the reaction with caustic soda increased its temperature. The third safety system was again the standard flare tower.

The three new systems that were devised by the experts were based on the high propensity of MIC to react with water, but their flimsiness and simplicity drew much comment. The first of these consisted of a tarpaulin shamiana that covered the chimney through which the MIC escapes. This shamiana was to be kept constantly wet, so that any escaping gas, which did not get burned by the flare tower, would react with water and get converted to harmless dimethyl urea. The second system consisted of jute mattings hung up on the perimeter wall of the factory on the side of the worst-hit colony on December 3, Jayaprakash Nagar. These too were to be kept wet so that any escaping gas could react with water. The sixth safety system consisted of Indian Air Force helicopters hovering over the plant which could spray water on the escaping gas if needed. If despite all this, immediate evacuation became necessary, people would be warned through sirens and army units, kept on five minutes notice, would move in to help.

The jute mattings in particular attracted much derisive comment. Said Praful Bidwai: "There is a length of flimsy jute sacking fastened just over a short stretch of the boundary wall, which is grandiosely termed 'Safety System Five'. The sacking, ruffling in the wind, does not reach beyond 12 ft or 15 ft from the ground level, a rather low altitude for trapping the gas in case there is an accidental release. In fact, the leaking gas, the authorities have presumed without any basis, will also move in a very definite direction and it is not necessary (or as Dr Varadarajan says 'possible') to mount the sacking along the entire perimeter wall of the factory."

Apart from these safety systems, newspapers also commented on who was really in charge of the entire operation. Said 'The Times of India': "Inspite of the presence of the Indian experts led by Dr S. Varadarajan of CSIR, there is very little doubt as to who is really in charge. The team of Indian experts does not yet seem to be in full and direct nuts-and-bolts-level command. The details of the job have been left to the Union Carbide management. As Dr

### Carbide's Double Standards

Union Carbide has claimed that its plant at Bhopal is simply a smaller-scale replica of the plant at Institute in West Virginia in the US. But there is now damning evidence to show that the company has practised double standards in the installation of safety equipment and in the observance of safety and operational practices.

One, the company never installed in Bhopal the computerised pressure/temperature sensing system, which it has used for several years in the US plant as a warning device. Two, the community living near the plant had never been told of the significance of the danger alarm. The danger alarm had sounded several times accidentally in the past and resembled a nearby factory's shift change hooter. Many people on hearing the alarm after the gas leak actually rushed towards the factory. Thirdly, the community had never been informed about the dangers posed by the materials used in the plant. Several neighbours thought that the plant made medicines. This contrasts sharply with the right-to-know laws in West Virginia and other US states. In West Virginia, Union Carbide is forced by law to inform people regularly about the dangers they face and instruct them about appropriate action during an emergency.

Safety conditions within the Bhopal factory were extremely bad as compared to the Institute plant. The record of plant accidents has been much worse than the US plant. There has been no death in the US plant in 17 years of MIC use. There was one phosgene spill in which one person was treated at the plant dispensary and others sent for X-rays. In 1978, MIC was released when a line broke while loading tank cars. One man was hospitalised for two days and 13 were treated at the plant dispensary. On the contrary, the Bhopal plant has been plagued with problems since it started. December, 1978, there was a major fire in the naphtha storage area. In December 1981, a phosgene leak killed a maintenance worker. In January 1982, a phosgene leak left 24 people severely ill. In October 1982, a flange broke and a mixture of gases (MIC, chloroform and hydrochloric acid) escaped, causing a mini-stampede in the slums around the plant. In 1983, there were two more minor leaks and in January, 1984, a factory worker died of a chemical allergy after working at the plant.

The Bhopal plant's management gave little heed to safety and maintenance. Engineering control equipment had not been working for a long time before the December gas disaster, the result of an indiscriminate economy drive. Control instruments at the plant were faulty. The MIC refrigeration unit had not been in operation for months, contrary to safety rules. The caustic soda scrubber and the flare had been out of service.

Maintenance and operational practices had sharply deteriorated. Chemical reactors, piping and valves were not purged, washed and aired before maintenance operations, which caused the death by phosgene in 1981. Lack of adequate spare parts meant that vital devices like pressure guages were not functioning. Underqualified people were running the plant at the time of the December release. People with chemical engineering backgrounds had been replaced by less skilled operators. The number of blue-collar workers at the plant had been reduced from 850 to 642 over the two years preceding the event. Shortly before the disaster, the operators' duty relieving system was suspended. If someone failed to appear for a shift, the plant would simply run without the operator.

The operating manual supplied by the US company was also grossly inadequate. The MIC control room plant manual did not have instructions for procedures to follow in the event of a rise in temperature or pressure of stored tanks of MIC.

There was only one corporate health and safety audit over the seven years of plant operations. No follow-up check was undertaken after 1982 even though conditions were becoming visibly worse, and local newspapers and politicians had raised alarm signals.

The only conclusion possible is that the Union Carbide didn't care about safety, and, in a developing country, with inadequate government regulations and a relatively uninformed public, it was simply cheaper and more profitable to neglect.

## Who Is To Blame?

Union Carbide's coming to Bhopal was welcomed by all, because it meant jobs and money for Bhopal, and saving in foreign exchange for the country, with the rising demand for pesticides after the Green Revolution. The first phase of the project was completed in 1977 and the second in 1979; total cost: Rs 25 crore. Pesticide formulation developed into pesticide manufacture and in 1983, the company's licenced capacity stood at 5,250 tonnes of MIC-based pesticides, 200 tonnes of methabenzthiazuran, and 50 tonnes of propoxur.

The MIC plant was troublesome from the very first year and there were several leakages, light and heavy, until the Bhopal disaster. The first death occurred in 1981, when plant operator Mohammed Ashraf died. However, the government steadfastly ignored warnings, notably from M.N. Buch, administrator of the Bhopal Municipal Corporation, who issued notice to Union Carbide to move out of Bhopal in 1975. Buch was soon transferred and the company donated Rs 25,000 to the corporation for a park.

The warnings kept coming. In May 1982, three experts from Union Carbide Corporation, USA, surveyed safety measures and pointed to alarming lapses: water could contaminate the tank, the tank relief valve couldn't control a runaway reaction, manual filling could lead to overfilling, the phosgene tank pressure gauge was defective, valve leakage was endemic, there was no water spray system for fire protection or vapour dispersal in the MIC operating or storage area. These fears were repeated in a local weekly, 'Rapat', edited by Rajkumar Keswani in three prophetic articles in 1982 titled: "Sage, please save this city," "Bhopal sitting on the brink of a volcano" and "If you don't understand, all will end."

At about the same time the factory's employees union also wrote to Central ministers and the chief minister warning of the situation. The state Labour Minister, Tara Singh Viyogi reassured legislators at various times that the factory was safe, adding at one point: "It is not a stone which I could lift and place elsewhere. The factory has its ties with the entire country. And it is not a fact that the plant is posing a major danger to Bhopal or that there is any such possibility". The enquiry begun after Ashraf's death took two years to complete, the report was finally submitted on March 1984. Nobody read the report thereafter and only in January 1985—after the December disaster—were those responsible asked to proceed on leave and explain their negligence. Only a few weeks before the gas leak, the factory had been granted an "environmental clearance certificate" by the state pollution control board.

The Central government rivalled its state counterpart in casualness. It ignored the plant's safety record in granting the letter of intent and later the industrial license in 1983, and ignored Department of Environment guidelines on the siting of hazardous plants. It extended the license allowing Union Carbide to extend its collaboration with the parent corporation on the assurance that Union Carbide Corporation would provide safety know-how and technology for handling situations like toxic gas releases on a continuous basis.

Why the warnings were ignored is clear. The company employs the relatives of powerful politicians and bureaucrats. Its legal adviser is an important leader of the Congress(I) and the public relations officer is the nephew of a former education minister of the state. The company's well-furnished guest house at Shyamala Hills was reportedly always at the disposal of the chief minister and many Union ministers stayed there during a Congress convention in 1983. Arjun Singh is himself facing a court case alleging that he had personally received favours from Union Carbide: his wife received generous hospitality from the company during visits to the US in 1983 and 1984 and the Union government has admitted that the company, as per its records, donated Rs 1.5 lakh to a children's welfare society in the chief minister's hometown, Churhat.

Union Carbide Corporation also played its full part in the run-up to the tragedy. It did not have a computerised early warning system. Indeed, one of the authors of the 1982 safety report C.S. Tyson, emphasised that the onus was on the human being in Bhopal, rather than on automatic systems. He alleged that Indian workers were not asking "what if" questions. The company had not worked out emergency evacuation procedures with the local community.

The plant was clearly not being maintained, and operated with the requisite level of efficiency (see box Double Standards). Morale was low because sales were dropping and the plant was running at a third of its capacity—it had never worked at even two-thirds of its capacity. For another, the alphanaphthol plant had to be abandoned—alphanaphthol is reacted with MIC to produce carbaryl—because during the trial runs it was found that even if alphanaphthol of the right purity could be made the cost of production would be higher than the imported cost. Workers allege that the plant's 200-page safety manual was hardly followed and in any case it doesn't specify all the necessary emergency procedures. Many instruments were out of order.

On the personnel front, too, there was laxity. Between one-half and two-thirds of the engineers who were there when the project began had left by December 1984. Several operators had left and staff from the abandoned alphanaphthol plant arbitrarily posted to vital positions in the MIC plant. Operator strength was reduced: in the MIC plant each of the three shifts were to be run by six operators instead of 11. The MIC control room was managed by two operators earlier; at the time of the accident, there was only one who found it virtually impossible to check the 70-odd panels, indicators and controllers. During shutdowns—as was the case when the accident took place—the understaffing was even more.

The plant was also underdesigned. Take the scrubber, the key safety device. The assumed normal feed rate of MIC gas is 86 kg/hour. During the incident, the peak flow could have been as much as one tonne per minute. The scrubber was simply overwhelmed. Carbide cannot also plead that it didn't know about the inadequacy of the scrubber to deal with a runaway reaction. In July 1984, its own engineers in the US had warned that the system was not good enough. As MIC tanks had been contaminated with reactants like water several times before, they had advised UCC to warn all operating personnel worldwide. But no such warning was passed on to Bhopal.

The second safety device in Bhopal, the flare tower, even if it was in operation, also might not have worked. As Union Carbide Works Manager Mukund told a journalist: "The flare tower is not designed to handle anything but a small quantity of MIC, such as a few hundred litres an hour. It could not take the 40 tonnes that was released during the accident; that would have created a massive explosion and the flare tower would have collapsed. The proposition is altogether absurd."

The magazine 'Business India' has alleged in a detailed article that water could have gone into the MIC tank through a piping modification: a jumper line that had been put in to interconnect the relief valve vent header and the process vent header lines, both of which lead into the scrubber. This was a major design modification, and the local subsidiary had undertaken the task only after clearance from UCC.

In any case, UCC alone is responsible for designing a plant which stores such large quantities of MIC. Mitsubishi Chemicals in Japan uses MIC but does not store it at all. Said the company's manager: "The material is too dangerous to store in a tank".

UCC has tried every gimmick to pass on the buck. It has blamed its local subsidiary, the Bhopal plant's workers, and has even tried to suggest sabotage. Carbide's Vice-President, Jackson Browning has insisted that water could not have accidentally got into the tank: "It would have taken a bushing or some adaptive device to hook (the water hose) up and force the water in". But when asked by a US Congressional panel, Chairperson Warren Anderson admitted that he had "no evidence whatsoever that sabotage was behind" the Bhopal disaster.

Varadarajan says, 'We didn't really know the plant all that well.' Even more significant, the involvement of the managers of Union Carbide Corporation, USA in the present operation is visible."

The very UCIL officials that were arrested on the first day of the tragedy, were released on bail on December 16, on the condition that they would help in the neutralisation of the gas left in the plant. And the neutralisation experts included the same W. Woomer from USA who was earlier denied entry into the plant for fear that he would destroy evidence.

**Matter of faith**

Even more ironical, at the end of all this sophisticated technology and expertise, it was still a matter of faith. The chief minister announced on the evening of December 15: "The scene is set for the operation to neutralise the poisonous gas in the Union Carbide plant. Even though the actual handling is to be done by the Union Carbide people taking full responsibility, the go-ahead has to be given by us — that is me. It is no doubt one of the most crucial and agonising decisions I have been called upon to make. In such moments of supreme loneliness, nothing impels us more than one's faith in our creator. Even though faith springs eternal in the human heart, at this moment of time it stands rudely shaken by horrendous events of last few days. That faith has to be restored. This operation shall, therefore, be called Operation Faith. Let us pray for its success."

Said 'The Hindustan Times' on this announcement: "It was not so much the fear of the lethal gas as the 'crisis of faith' that had forced a few lakh people to flee the city. The chief minister's statement issued on the eve of the operation was generally interpreted to show that he himself was not quite confident about the course he had chosen to dispose off the MIC gas."

However, overnight the preparations for the operation began. Water tankers and fire brigade vans drenched every street with water, though nobody knew how this would prevent the gas from affecting people. The policemen on duty prepared for their own safety by keeping ready buckets filled with water and small towels. At the factory itself, fire tenders drenched the jute screens on the perimeter. Other fire tenders sent jets of water soaring into the screens covering the MIC section of the plant. Once every five to 10 minutes a helicopter would hover over the plant spraying water, and occasionally even over neighbouring colonies. Hundreds of oxygen masks were rushed in for plant personnel to use as a safety measure.

At 8.30 am on December 16, the operation started with the much publicised presence of the chief minister, who even took time off to argue with journalists that only 85,000 people had left the city. The governor, Professor K.M. Chandy, who had earlier refused to drink any water in Bhopal, also visited the plant twice. Outside the factory's gate, Bharatiya Janata Party President Atal Behari Vajpayee argued with policemen who first denied him permission to enter the plant and then allowed him in. By the end of the first day, four tonnes out of the 15 tonnes estimated to be in storage tank No 619 and 1.2 tonnes in stainless steel drums, were converted into pesticides.

The next morning, the same routine of fire tenders and helicopters was repeated. In front of the gate, to instil confidence in the people, stood two army officers, Brigadier N.K. Maini and Major G.S. Khanuja, who had risked their lives on the morning of December 2 to evacuate some 10,000 people. By the end of that day, another four tonnes had been used up.

By the end of the third day, 12 tonnes had been disposed off, leaving just about four more tonnes to be converted. But by that day, the government team also realised that there was a lot more gas in the tank than the factory's records had earlier indicated. The operation which was expected to end in four or five days finally ended on Saturday seven days after it began, and nearly 24 tonnes of the gas had to be converted, over 50 per cent more than earlier estimated. Union Carbide did not even know how much gas it had in store.

**The company's engineer responded: "The gas leak just can't be from my plant. Our technology just can't go wrong." (Raghu Rai)**

## The government's response

The government's response was uncertain and tardy. The Central government, at the request of the state government, flew in a team of doctors, followed by a Central Bureau of Investigation (CBI) team. The district magistrate ordered closure of the factory on December 3 itself and arrested five officers of the company in Bhopal. A judicial enquiry into the tragedy was announced. The next day two teams of chemical industry and environmental experts were flown in from Delhi. The new Prime Minister, Rajiv Gandhi, broke his election campaign to fly to Bhopal.

But apart from these routine bureaucratic responses, the state or the Central government did precious little during the first two days. Except for the army, there was no help coming to the 100,000-odd people who fled from their homes that morning. Bhopal's superintendent of police claimed that police used whatever vans and trucks were available and took people out of Bhopal. But he argued that as the administration had no clue of the nature of the gas leak, there was little it could do.

The government's centralisation and lack of initiative, so visible on ordinary days, caused it to literally collapse under stress. Individuals in the administration worked themselves to the wall but there was no overall planning. In those first few hours, there was complete confusion. Once the leak had been confirmed the government apparently decided to evacuate the city. But no one announced this decision to the public at large. The only people who got informed through the government grapevine were the elite: the ministers and those who lived in the colonies far from the plant, and even among those it was mainly people who had telephones. The rest of the people were left to fend for themselves. Said 'Frontline': "Neither the state government headed by a panicky and strange-acting Arjun Singh, nor the Central government, seemed to know how to respond to this calamity." Had it not been for the valour of the army, the death toll would have been considerably higher.

The first coordination meeting of secretaries and heads of departments was called only on the night of December 4, more than 40 hours later. Fortunately, there was a stock of medicines available in the town because of the national programme to combat blindness. For two days, some 2,000 animal carcasses still littered streets and houses and posed a real danger of a cholera outbreak. Finally, cranes and dumpers were obtained from the army and Bharat Heavy Electricals Ltd. The coil of one crane actually broke when lifting a dead buffalo. The walls of 32 houses had to be broken down because the buffalo corpses had bloated so much they couldn't be taken out of the narrow doors of the slum houses. Finally the dead animals were carried 5 km away from the city and dumped in 10 ft deep trenches, dug by bulldozers and lined with four trucks of salt, two trucks of bleaching powder, 10 trucks of lime and half a truck of caustic soda.

### Epidemic fears

But three weeks later, there were again fears of outbreaks of epidemics as millions of green flies, attracted by improperly disposed off carcasses invaded the city. The army had initially helped in the removal and disposal of animal carcasses but the authorities admitted that all the animals could not be buried because of a shortage of sanitary workers and scavengers. Most of the local municipal staff had been affected by the gas and sanitary workers had to be summoned from other towns.

**The first patient came at 1.15 am; within five minutes a thousand. Nobody knew what had hit them. (Hindustan Times)**

Equally disorganised and callous was the administration's response to people's queries. The government began to put out news bulletins over All India Radio on the second day itself that the situation was fast returning to normal and that everything was safe, which journalists told the chief minister sounded much like the pronouncements of Carbide officials. The people were suspicious about the air they breathed, the water they drank, and the meat, flour, fish and vegetables they ate. They wanted to know whether the dead animals would lead to an epidemic, whether any gas remained in the factory and whether it could leak out again.

Instead of taking the people into full confidence, there

## The Controversial Antidote

Was it MIC? Or phosgene? Or a mixture of both? Or some other gas like hydrogen cyanide?

It was confusion confounded. Amazingly, even as hundreds died in Bhopal, the confusion over what it was that was killing them persisted right through the horrendous first week and after. Nobody knew anything, including experts at the Union Ministry of Chemicals in New Delhi.

At first, the majority of doctors in Bhopal plumped for phosgene, partly the result of the prompting of local Carbide officials, who kept on insisting that MIC is only an irritant and not lethal. Moreover, phosgene vaporises at low temperatures (8°C), unlike MIC (above 38°C), and is far more likely to have done so that cold December night. So felt Dr J.M. Dave, dean, School of Environmental Sciences, Jawaharlal Nehru University, and he also added that while MIC does not cause visible damage to plants, phosgene does. Dave was backed up by seven teachers from the chemistry department of Nagpur University. Not more than a handful of doctors in Bhopal in the first five days, knew or believed that the gas was MIC, or that it was toxic at all.

Later, opinions veered round to MIC. Scientists of the Indian Agricultural Research Institute in Delhi claimed that tests on affected plants had revealed traces of MIC not phosgene. Experts at the Industrial Toxicology Research Centre (ITRC) in Lucknow also said that there were "very little chances of phosgene being the killer gas" as it causes delayed pulmonary oedema—lungs swollen up with water—and does not kill immediately, as happened in Bhopal.

Days later, opinion had veered yet again, to a mixture of both. Dr S.R. Saxena of the Safdarjung Hospital in Delhi, who led the expert team despatched by the Central government said that two gases appeared to have been at work because of the changing symptoms of the patients. "The reaction to one came within a couple of hours and to the other after a passage of 48 to 72 hours." This could be evidence that phosgene, which has delayed effects, was mixed with MIC. Dr S. Varadarajan, director-general of the Council of Scientific and Industrial Research, who had earlier asserted that only MIC was responsible, pointed out towards late December that pure MIC is unstable and as such is always stored with a small amount of phosgene as impurity, usually between 200 ppm and 300 ppm. He said that the phosgene content in the killer tank was higher, about 500 ppm.

Union Carbide's own pronouncements from the US added to the chaos. Carbide's medical director in the US, Bipin Avashia, cabled the authorities in Bhopal to administer sodium thiosulphate to the victims "if cyanide poisoning is suspected". But at his press conference in Bhopal, ten days after the disaster, Avashia got into a slanging match with Bhopal's doctors crying out: "It is not phosgene, it is not phosgene, it is not phosgene". He argued that there could be no cyanide poisoning and sodium thiosulphate was no antidote to MIC poisoning. Union Carbide even issued a statement: "MIC is not a cyanide. In no way should it be confused as such. MIC naturally degrades in the environment by reacting readily with water to become harmless substances while cyanides do not react with water." But when quizzed how he could have suggested administration of sodium thiosulphate in his first cable, he simply said that he could not be expected to know what sort of gas the Bhopal plant stocked. However, the telexed prescription had clearly referred to "treatment of MIC pulmonary complications".

The victims suffered in the confusion. The treatment was mainly directed towards alleviation of eye and lung symptoms and each symptom was treated separately: eyedrops for smarting eyes, steroids for inflammation, antibiotics to prevent secondary infection, antacids for the stomach and oxygen respirators in acute cases.

Patients were administered Lasix for oedema and lung inflammation and according to some experts, the effect was devastating. Patients had come to hospitals complaining of intense heat and thirst. A large number of corpses had come to the morgue naked, as if they had ripped off their clothes in desperation. Administration of Lasix only increased dehydration.

In the meantime, controversy arose over the possible antidote. Professor Heeresh Chandra, director of the Medical-Legal Institute in Bhopal had immediately conducted autopsies. His most important finding was the dark, cherry-red colour of the blood, a phenomenon that was later observed also in dead cattle. Organs like the lung were also red. If death had occurred because of suffocation as a result of excess fluid in the lungs, then the deoxygenated blood should have been bluish. Though the patients were dying of 'acute respiratory distress', the red colour indicated that the blood had oxygen in it. Clearly some poison was blocking its use in the cells.

Intrigued by the red colour, Heeresh Chandra argued that death was due to or similar to cyanide poisoning and pushed for the immediate use of sodium thiosulphate—the known antidote—as patients were still dying. A large number of deaths occurred within the first 48-72 hours. But, for inexplicable reasons, he only met ridicule from his own colleagues who demanded more evidence. Said N.P. Mishra: "You are a doctor of the dead, so do not interfere with the living." This, despite the fact, that sodium thiosulphate is known to be a harmless drug, definitely far safer than the massive administration of antibiotics and steroids.

On December 8, as patients were still dying, German toxicologist Max Daunderer administered sodium thiosulphate to a few desperate cases. While one patient showed remarkable recovery, another died and word went around that the German doctor had killed a patient using sodium thiosulphate. The German was bundled out of Bhopal. A congress of senior professors of Gandhi Medical College presided over by Dr K.W. Jaeger a WHO toxicologist, rejected a proposal to use sodium thiosulphate. And M.N. Nagu, director of health services in the state government sent out a circular on December 13 stating that "under no circumstances shall sodium thiosulphate be given unless it is correctly and conclusively proved in the laboratory that it is cyanide poisoning." In Bhopal, the word was that Nagu had been so informed by the Indian Council of Medical Research, ICMR but ICMR's own circular of December 14 addressed to doctors in Bhopal, which included a pamphlet on the use of sodium thiosulphate, a tacit endorsement of the drug, was not made available to them by the state government until January 7. But even then there was no large-scale administration of sodium thiosulphate.

was a volley of confused and contradictory statements. A newspaper report pointed out that on December 4, on his visit to Bhopal, Rajiv Gandhi had declared that the water had been tested and that no toxic substances had been found in it. But Varadarajan later revealed that testing started only on December 5. Not suprisingly when it came to neutralisation of the remaining gas, the people simply fled the city in unprecedented numbers.

The CBI team which arrived on December 3 itself immediately began interrogation of officials and the supervisory staff of the plant, warned Carbide officials not to leave Bhopal without permission, and seized all log books and relevant papers pertaining to the storage and release of MIC. When a team of US technical experts of the Union Carbide Corporation (UCC), USA, headed by former works manager W. Woomer turned up in Bhopal three days after the disaster, the government refused them entry into the plant as they could destroy evidence.

### Arrest fiasco

But the manner in which the government handled the arrest of Warren Anderson, the UCC chairperson, was ridiculous. As Anderson landed in Bhopal with Union Carbide of India Ltd's (UCIL) Chairperson Keshub Mahindra and Managing Director V.P. Gokhale, all three were taken into custody, whisked away in a car with a heavy police escort to the company's guest house, and lodged in separate rooms from which telephone lines had already been disconnected. They were charged with a series of offences, several of which are non-bailable and punishable with life imprisonment or terms ranging from five to 10 years.

A government official said that the arrests were made for "constructive criminal liability for the events that led to the great tragedy". The chief minister himself boldly declared: "This government cannot remain a helpless spectator to the tragedy and knows its duty towards thousands of innocent

**Western papers called these dead children the 'pain of progress' and the 'balance sheet of death'. (Raghu Rai)**

Carbide's role in this controversy remains shrouded in mystery but was probably crucial. Admitted Dr N.R. Bhandari, Hamidia's medical superintendent to journalists, "Dr Avashia told us it was not necessary or advisable to use sodium thiosulphate." Nobody in authority seems to have realised that UCC, facing the world's biggest compensation claim and for which MIC is a major product, could have been deliberately playing down the ill-effects of MIC.

However, with the symptoms of poisoning persisting and Carbide's prediction that MIC would not lead to many long-term effects looking more and more like a lie, the demand for sodium thiosulphate as a detoxification agent has also grown. Voluntary groups like the Zahreeli Gas Kand Sangharsh Morcha, Nagrik Rahat aur Punarwas Samiti and Medico Friends Circle have strongly argued for mass administration of the drug, while newspapers have given them prominent coverage. In early February, the ICMR held a press conference to announce that it was now tentatively convinced that MIC-affected patients were suffering from chronic cyanide poisoning, though it was not able to say where this cyanide was coming from. It could have come directly through the inhalation of a gas like hydrogen cyanide (which could have been mixed with the MIC released from the tank) or it could be the breakdown product of MIC in the body adding to its "cyanide pool". ICMR instructed the state government to use sodium thiosulphate because patients given the injection reported remarkable improvement, and tests showed 8-10 times increased quantities of thiocyanate in the urine, which indicated that the body was getting rid of the poison. In early May, ICMR announced that biochemical tests had confirmed that MIC had affected the haemoglobin in the blood through a 'carbamylation' process, reducing its ability to carry carbon dioxide away from the tissues. Thus, even though the blood was rich in oxygen, tissues were starving for it.

The confirmation of cyanide poisoning has raised the possibility of hydrogen cyanide being one of the gases that afflicted the people of Bhopal. Suspicion that UCC has been suppressing information has grown. Contrary to its own assertion that cyanates do not break down into cyanides, a 1976 UCC publication itself points out that "under thermal conditions" MIC breaks down into hydrogen cyanide. As the gases had come out of the MIC tank at a high temperature—maybe even as high as 400°C—they could also have contained hydrogen cyanide. Tests in France have shown that MIC when burnt with air gives rise to hydrogen cyanide.

For some inexplicable reason, even after ICMR's stand, little seems to have moved in Bhopal. The state's health secretary has issued a statement criticising Carbide for its callousness in refusing to divulge information relating to proper treatment of gas-affected victims. But even until May, thiosulphate had been given to extremely few people. The only place administering thiosulphate in Bhopal was the 30-bed hospital, hastily set up by ICMR for gas victims in a shabby police bungalow. Several local doctors tried their best to undermine the thiosulphate therapy—N.P. Mishra claimed that even glucose injections given as a placebo had more patients claiming improvement—while others spread rumours about imaginary harmful effects of thiosulphate. The authorities also starved the ICMR hospital of proper facilities. They could not spare even an air conditioner for its sophisticated equipment kept in the outhouse. In late March, Saheli, a Delhi based women's group, organised an angry demonstration of 150 women to demand immediate thiosulphate treatment. Dr Nagu received their memorandum but said he had no communication from ICMR regarding thiosulphate treatment.

Pointing out that if UCC had been honest about cyanide poisoning, hundreds of lives may have been saved, an angry article in 'Business India' concluded: "the impression is inescapable that there were concerted efforts by the senior-most members of Bhopal's medical establishment to suppress information on the nature of this mass poisoning." Said Tania Midha in another report in 'The Telegraph', "Interestingly, most documents produced by Dr Mishra in refuting the validity of Dr Heeresh Chandra's claims, are studies by Dr Bryan Ballantyne, the expert sponsored by Union Carbide to visit Bhopal."

## Deadly Environment

For days the people of Bhopal were on tenterhooks. Are air and water safe? Are fruits and vegetables edible? What about fish and meat?

The authorities gave out limited information and only added to the confusion. They said 'the water is safe, but boil it before you drink'; the 'vegetables are safe, but wash them before you cook'; 'the fish is safe' but promptly closed the fish and meat markets and banned the slaughter of animals. They refused to answer questions about what tests and when they had been conducted. The Bhopal Municipal Corporation, for instance, promptly declared that water was safe. But what had the water been tested for? MIC? Its derivatives? Its carcinogenic derivatives? What were the types of tests conducted? How safe was 'safe'? No effort was made to take the public into confidence.

Eklavya—a voluntary agency funded by the Madhya Pradesh government to promote science education in village schools—immediately took steps to organise tests of air, water, plant, flour and charcoal samples, emphasising the people's right to know. But it soon came up against the fact that most scientific laboratories are controlled by the government and only an occasional scientist was prepared to help. Tests, therefore, had to be conducted in various parts of the country.

Government reports have come out slowly. A team from the Indian Council of Agricultural Research (ICAR), which arrived in Bhopal on December 11, found that animals had died within 3 minutes of inhaling the gas. They were frothing from the mouth, full of tears and breathless; many cows miscarried. "In clinically ill animals," reported the team, "there was an immediate drying of milk after exposure and milk production came down from about 8 kg to 10 kg per day to 0.5 kg to nil."

Official records put the number of dead animals—cattle, goats, sheep and so on—at 1,047, while about 7,000 received therapeutic care. Poultry, it seems was relatively less affected, for inexplicable reasons.

Samples of fish, plankton and water were taken from 15 locations. Bhopal is famous for its lakes. As fish in affected areas were found to be suffering from anaemia, the ICAR scientists felt that further studies were required and have since been collecting data on the effect of Bhopal's effluents on Indian carp like catla and mrigal. As with the case of human beings, there is no scientific data on the likely impact in the long run of MIC on animals, insects and plants.

The effect of MIC on plants and soil was also studied by the Central Board for the Prevention and Control of Water Pollution. The board used neem as an atmospheric indicator because it was found to be one of the most sensitive trees. A vegetation damage contour map was prepared to indicate which parts of Bhopal were hit by the deadly gas. The board found that the vegetation in an area of 3.5 sq km around the factory was severely affected, 10.5 sq km was badly affected, 6 sq km moderately and 5 sq km mildly.

Leaves bore the brunt of the damage: methi saplings, for instance, showed symptoms of scorching and all the top leaves had withered. Methi and brinjal seedlings were found to be most sensitive. These plants were completely destroyed even 3 km to 4 km away from the factory. Even after eight days, none of the methi and spinach plants examined showed any signs of recuperation. Other severely damaged plants were castor, neem, karanja and ber, whose leaves were completely bleached, curled up and were falling. The scientists found that there had been instant death in the exposed tissues.

Interestingly, the same species of plants which were otherwise badly affected, were unharmed when found growing near lakes, which probably shows that water had a scavenging effect. It was claimed that the lakes had prevented the MIC from creating an even more widespread havoc.

As a precaution, the board's team suggested that the consumption of fruit from trees in afected localities—specially ber, mango, papaya and tamarind—should be avoided for at least a season.

A team of scientists from the Banaras Hindu University has also warned the people of Bhopal against consuming locally grown vegetables till after the monsoon as these have shown genetic defects. MIC seems to have acted as a mutagen. They have advocated the destruction of all standing crops and to keep the land fallow till after the monsoon.

These scientists have also found that several wild plants were less damaged than cultivated plants. Plants submerged in water escaped the wrath of the gas while leaves of floating plants got scorched. Many birds escaped death presumably because of their habit of pushing their beaks inside their feathers while asleep. A health department official even reported a bright side to the disaster. Gas-affected areas have recorded a reduction in malaria incidence. Mosquito breeding grounds have apparently been affected by MIC.

### List of plants damaged by MIC

| Completely damaged | Partially damaged | Undamaged |
|---|---|---|
| Methi (fenugreek) | Alfalfa | Mint |
| Radish | Mustard | Arvi |
| Spinach | Cabbage | Cuscuta |
| Brinjal (fruits turned yellow) | Cauliflower (only leaves were scorched) | Parthenium |
| Tomato | Water hyacinth | Wild rice |
| Chenopodium | Marigold | Bougainvillea |
| Castor | Coriander | Moringa |
| Datura | Rose | Date-palm |
| Jasmine | Bottlegourd | Jamun |
| Calotropis | Wild spinach | Mango |
| Lantana | Lemon | Kaner (oleander) |
| Ber | | Banana |
| Neem | Guava | Kaitha |

Source: Indian Council of Agricultural Research

**Over a thousand animals died within minutes of inhaling the gas; survivors stopped producing milk (Ashok Chaddha)**

citizens", and charged that lives of citizens had been "so rudely and traumatically affected by the cruel and wanton negligence on the part of the management of Union Carbide". An early release of an Indian news agency even declared that the officials of the multinational UCC "can be sentenced to death".

But this bravado, which even brought protests from the White House, ended almost as soon as it began. Within six hours of his arrest Anderson was whisked away from Bhopal in full secrecy, without being produced before a magistrate, as normally required under law, with a paltry bail sum of Rs 20,000, put on a government plane and flown to New Delhi. Said an embarrassed chief minister who tried to make the best of the situation: "What has been done is within the four corners of the law . . . We wanted him to go in the overall public interest. Not that I feared violence but it could have happened." But few were impressed by this feat. Said 'Nai Duniya': "The government is staging this drama in order to hide its own shortcoming with regard to the gas tragedy."

The worst record of the government was in the manner it took up relief work. On December 9, the government announced an immediate relief of Rs 100 for ordinary injuries and Rs 2,000 for seriously injured persons. This immediately became an excuse for political favours. At Hamidia Hospital, a Congress(I) municipal councillor insisted that doctors readmit a patient while doctors alleged that the patient wanted to take the relief money of Rs 2,000 by being admitted to the hospital for five days at a stretch, even though he was fit to be discharged. The doctors resented this political interference and went on a lightning strike. They relented only when the corporator apologised. Said a strike placard: "Congress musclemanship is deadlier than MIC."

Newspapers also reported considerable resentment over the distribution of relief money. One gas-affected woman whose eyes had been badly affected wanted to return the paltry relief money of Rs 200 that she had been given. Financial assistance was handed over in crossed cheques. To cash these cheques, the victims had to first get themselves identified and open an account in the banks after depositing Rs 20. The banks had to seek special permission to open accounts for those poor families who did not even have the initial deposit of Rs 20.

### Resentment and relief

People expressed their growing resentment in various ways. Youth in various gas-affected localities began to gherao medical teams. Less than 10 days after the disaster, an 'Economic Times' reporter was taken to houses by angry youth to assess the situation for himself. "Almost every house gave the appearance of a hospital ward," he said in his report. "Almost everybody was coughing constantly, having pain and irritation in the chest. Nobody had turned up to provide these people with medicines or to examine them for the last two to three days. Many of the sick people were not in a position even to get up from their bed. Most of them are daily wage earners. They were not getting anything to eat. They had no resources to purchase foodgrains. Even if they purchased foodgrains, the women were not physically fit to cook their meals. The moment they sat near the fire, their coughing increased. These people generally belong to an economic class which suffers from malnutrition. If they are denied meals in such a shattered physical condition, they would have no resistance left." On December 9, there was even a demonstration in front of the chief minister's residence.

Most of the affected people were poor, manual, daily wage workers and they found themselves suffering from the effects of MIC even weeks after the exposure, the chief one being persistent breathlessness. Manual labour became impossible: they felt dizzy even walking one kilometre in the sun. And out of work and money, they found themselves even more diseased, weak and hungry, virtually on the verge of starvation. The entire eposide left the survivors, their health and their economy totally shattered.

Describing a typical situation, 30-year-old handcart puller Sabir Ahmed said that he had ventured out to work nearly three weeks after the gas leak. But this breadearner of a five-member family had to return home soon feeling ill. Porter Bilal Ahmed was in a similar situation: he had received treatment on December 3 at Hamidia Hospital but nothing after that. And he was still experiencing irritation in the eyes, chest pain and nausea, and was finding it impossible to work. Shravan Singh, 34, a lathe operator, now found his earlier occupation which used to fetch him some Rs 25 a day, so tiring that he had to turn to selling roasted gram as a pavement hawker earning less than Rs 10 a day to feed his family of four.

Women often found themselves in a worse situation. They continued to be plagued by blinding headaches, dizziness and could not focus on anything for long. Cooking before the fire brought about exposure to woodsmoke and increased the irritation in their eyes, making it impossible to cook more than two chappatis at a time. Bringing water from the nearby well or tap tired them out for the whole day. Many women had lost their sons and husbands and now it was impossible for them to survive, especially as they could not work in their diseased condition. Many of the women living in J.P. Nagar opposite Union Carbide, are bidi workers. Said one bidi worker: "We cannot see the bidi thread after a while; our eyes burn. And unless you make a sizeable number of bidis and sell them each day, there is no profit." Some bidi workers found that the person who used to purchase bidis from them was dead and therefore there was nobody to sell bidis to even if they could make bidis. The mass death of animals like buffaloes also meant hardship for many people who had lost their sole occupation.

### Long wait

In a desperate bid to get themselves cured, people sat in long queues before mobile clinics, dispensaries and polyclinics set up by the government, and a dozen other dispensaries set up by voluntary agencies. At these centres, they got the same treatment, antibiotics and a few other drugs, which after a while began to create more side-effects than benefits. Those unable to bear their health problems tried to seek the assistance of the big hospitals but from there they were invariably turned back.

Others simply lay at home in bed. But with the government and the medical community in Bhopal arguing in less than a fortnight that the worst was over — that most of the problems people were now complaining about were mainly the result of common diseases like anaemia and TB, rampant in these slums — the people found themselves caught between a callous multinational and a highly inefficient and equally callous government.

Voluntary agencies working in the affected settlements reported innumerable health problems. Said the Nagrik Rahat aur Punarwas Samiti organised by film-makers Tapan Bose and Suhasini Mulay: "Our women volunteers have found that almost every woman exposed to MIC is suffering from severe disorders of the reproductive system in addition to respiratory and gastric complications. They complain of up to five menstrual discharges during the last six weeks with moderate to heavy bleeding. Most women are complaining of abdominal pain, and highly acidic vaginal secretions which cause burning and pregnant women are facing even greater problems." The government did not pay any heed to the committee's suggestion that five properly equipped diagnostic and therapeutic centres be set up in the affected areas.

The government itself did not attempt any serious documentation of the extent of injury and new symptoms emerging. No effort was made to take X-rays, collect and analyse blood, sputum or urine samples and keep people under observation. Even worse, the entire affair was shrouded in total secrecy. Even as people complained of various ailments, the government consciously tried to suppress all information. According to one report, the dean of the Gandhi Medical College in Bhopal even called a meeting of representatives of private medical practitioners in mid-January to demand that they disclose no facts pertaining to MIC poisoning to anyone but the state government.

## The Breathless Aftermath

Carbide's constant refrain from day one has been that MIC cannot lead to permanent damage or long-term effects. Said UCC's Chairperson, Warren Anderson in a letter written one month after the disaster to a group of Japanese protestors: "We sponsored visits by leading medical authorities here in the United States to visit Bhopal . . . .We are pleased that their experience in Bhopal and the news reports from there corroborate the beliefs of our own medical people, that those injured by methyl isocyanate are rapidly recovering and display little lasting effects."

This has definitely turned out to be one the most fraudulent statements of the century. Carbide has dismissed long-term effects even while it has professed total ignorance of the effect of high doses of MIC on human beings. For weeks after the disaster, every effort was made to play down the possibility of long-term effects by all and sundry: by Carbide, by Bhopal's doctors and even by experts of supposedly impartial international agencies like WHO. K.W. Jaeger, a WHO expert who rushed to Bhopal after the disaster, claimed that there was no basis for fearing that there will be many cases of paralysis or even of damage to unborn babies. In their press conference in Bhopal in December, UCC experts were at pains to explain that MIC could not be absorbed by the blood and, thus, cause long-lasting physiological changes because of its high reactivity with water and conversion into harmless products thereafter. The 'New York Times' on December 20 even headlined a major story: "Few lasting health effects found among India gas-leak survivors."

Of all places, disinformation has been at its peak in Bhopal, where a doctors' lobby has been reported close to the UCIL establishment. As reports of lung ailments and acute breathlessness continued to pour in, N.P. Mishra, head of the department of medicine at the Gandhi Medical College in Bhopal, told a journalist, "these are mostly previous diseases which get accentuated in winter. In fact, they're known as 'winter bronchitis'—people believe it's MIC." State government officials even tried to spread the word that the gas-affected people were living in poor, unhygienic colonies and were suffering from a high incidence of TB.

All this strongly contrasted with the reports pouring in from voluntary health organisations, individual doctors and journalists' own investigations. Voluntary agencies working in Bhopal reported nearly 200,000 affected people and about 50,000 seriously affected. Breathlessness, sleeping and digestion problems were reported to be so acute in 5 thousand to 10 thousand people that they were incapable of performing even light physical labour and would probably never be able to earn a living. Newspapers reported that many survivors were turning to begging.

Women were extremely badly affected. They found it impossible to carry even a pail of water home or cook two chappatis in front of the fire: their breathing would become difficult and eyes begin to burn. Said a team of doctors organised by the Medico Friends Circle (MFC), a nationwide network of voluntary health workers, "even most children find it difficult to play or participate in normal physical activity in the affected bastis."

As public consternation grew and newspaper reports continued to portray the acute suffering of the Bhopal people, the state government and the medical establishment responded with a clampdown on information. "Ask ICMR" is all that the medical establishment in Bhopal told the Telegraph's news editor, Shekhar Bhatia. Meanwhile, the Indian Council of Medical Research (ICMR) in Delhi admitted that it had advised "individual investigators not to publicise their findings prematurely and individually so as to avoid confusion and panic in the public mind through conflicting statements of the type being witnessed today." But this secrecy only fuelled the confusion.

Said D.R. Varma—a visiting professor of pharmacology at McGill University in Canada—in a press statement issued to counter official propaganda from Bhopal, "given the nature of known and serious toxic effects of a compound as dangerous as MIC, the possibility of serious short and long-term adverse effects on pregnant women and their offsprings is in my view very, very real." Voluntary agencies announced in anger that they planned to conduct their own health surveys to document the deplorable state of the survivors' health—the Bhopal-based Nagrik Rahat and Punarwas Committee with the help of doctors from the KEM Hospital in Bombay and the MFC through its nationwide network of voluntary health activists.

Finally, two months after the disaster, ICMR broke its silence. V. Ramalingaswami, the council's director-general, strongly denied the statement attributed to him that "there is no reason to believe that there will be any long term effects", and disclosed a multi-project research programme that ICMR had launched to identify the full spectrum of ailments being suffered by the gas victims, the biological mechanisms of the action of MIC, and a proper treatment (see box Controversial Antidote)

The council has since found through its epidemiological studies that affected areas can be divided into three categories: severely affected areas (in which more than five per cent of the community died), moderately affected (where 1 to 5 per cent died) and mildly affected (less than 1 per cent mortality). Over 60,000 people are living in severely and moderately affected areas.

Preliminary data gathered by the council revealed that even two months after exposure to the gas, nearly 40 per cent of those attending local hospitals were suffering from respiratory problems like breathlessness and cough. Another group of patients was suffering from gastrointestinal symptoms like nausea, vomiting and burning in the stomach.

Two ICMR psychiatrists reported that 10-12 per cent of the affected individuals attending local clinics revealed psychiatric symptoms, foremost being anxiety and depression. Many people were suffering from sleep disturbance, 'gas phobia', and

### Public protest

By early January, the mood turned angry and resentful. On January 1, the Nagrik Rahat aur Punarwas Committee organised a 'chakkajam' (stop the wheels) programme by squatting on the main thoroughfare of the city. On January 3, the Zahareeli Gas Kand Sangharsh Morcha, a forum organised by scientists, social activists and trade union workers, observed a Dhikkar Diwas (Day of Condemnation) and a dharna in front of the chief minister's house. The day-long dharna turned into a 10 day-long dharna and finally got converted into a 'rail roko' (stop the trains) programme. But many members of the morcha were picked up by the police even before they could march to the station and kept behind the bars for days. A few days later the chief minister organised his own, much-trumpetted Dhanyavad Diwas (Day of Thanks). The single biggest ground for resentment was the delayed distribution of ex gratia payments by the government, which had announced that Rs 10,000 would be given to the heir of every dead person, Rs 2,000 to those seriously affected and Rs 100 to 1,000 to those slightly affected. In its initial panic, the government had rushed payments and Rs 36.67 lakh was paid in cash to 5,724 victims. But on December 7, the government suspended the disbursement and announced that it would be resumed later — and payment would be by cheque — only after a quick house to house survey of the affected localities. But payments remained suspended well into January. No government department wanted to shoulder the responsibility of sorting the needy from the avaricious, who also wanted to cash in on the tragedy. There were other difficult questions. Who is an "affected" person? Which is the "seriously affected area"?

**Results of the KEM College medical survey 100 days after the exposure**

| | Adults in Group I % | Adults in Group II % |
|---|---|---|
| Respiratory symptoms | 79.7 | 27.6 |
| Eye symptoms | 65.6 | 31.5 |
| Gastrointestinal symptoms | 60.3 | 23.6 |
| Neuromuscular symptoms | 54.5 | 10.5 |
| Gynaecological symptoms | 75.5 | 53.84 |

Out of 250,000 exposed, population with medical disability:

| | |
|---|---|
| mild to moderate | 43,864 |
| severe | 63,385 |

Note: Group I: People residing less than 0.5 to 2 km from the factory.
Group II: people residing more than 8 km from the factory.

a feeling of hopelessness. These psychiatrists, thus, confirmed newspaper stories that children often wake up in the night crying *"bhago, bachao"* (run, save me). As many families were finding it difficult to cope with this abnormally stressful situation in their life, they strongly advised immediate psychiatric care.

In early February, the ICMR launched an extensive survey to cover about 100,000 people (about 21,000 families). By mid-March it had surveyed 11,185 people, of which 1660 were found suffering from lung problems, 1425 from eye problems and 5067 from both. The ICMR has also announced projects to study the possible carcinogenic, teratogenic and mutagenic effects of the gas. A cancer registry is to be set up soon in Bhopal. A British expert has warned that a highly reactive agent like MIC which can react with DNA and proteins in cells, could easily lead to cancer.

There has been considerable concern about the effect of the gas on women and, in particular, on pregnant women and unborn children. In a population of 100,000, there should be some 3000 pregnant women at any time. By mid-March, ICMR had identified 404, 97 of whom had already delivered. Of these five had still births, another 17 had already had abortions, and three newborns suffered from birth anomalies. Most of the babies examined were full term but low in birth weight. Mothers themselves were generally malnourished, anaemic and breastmilk was insufficient. The need for monitoring the condition of pregnant women who were in the first trimester of pregnancy at the time of the disaster has been stressed by ICMR. These cases would be due for delivery from June onwards.

Studies conducted by the MFC have revealed an extremely high degree of gynaecological problems. Rani Bang and Mira Sadgopal found that of 114 women they surveyed in the two most affected areas—J.P. Nagar and Kazi Camp—90 per cent suffered from leucorrhoea, 79 per cent from pelvic inflammatory disease (which could affect future pregnancies), 31 per cent (of non-pregnant women) from excessive menstrual bleeding and 59 per cent from suppression of lactation, which meant that infants were being weaned without adequate supplementation. All these figures were several times higher than those found in a non-affected Bhopal colony. Said Bang and Sadgopal: "As Indian women in general are shy and are reluctant to seek help for gynaecological problems, what we have found is only the tip of an iceberg."

The MFC study teams have also taken to task the local medical establishment for its totally inadequate and unimaginative post-disaster health care. One MFC team warned that a large proportion of the MIC affected population is certain to develop fibrosis of the lungs (development of scars), which will permanently affect breathing and working capacity. Simple breathing exercises could help to reduce this disability but no effort has been made to spread knowledge of these exercises. Another MFC team criticised the local doctors for not giving any advice to pregnant women about possible risks to the foetus. Not only had these women been exposed to an extremely toxic chemical, but they had also been administered a variety of drugs like steroids, which are known to cause foetal deformities. MFC strongly argued in favour of proper health education and provision of facilities for abortions, if necessary. The MFC team also advised all affected people to practise contraception until all symptoms of cyanide like poisoning had disappeared. The MFC suggestion that instead of hospital-based treatment, a cadre of paramedical workers and medical social workers ought to be created to provide treatment at home for acute symptoms, for identification of serious and chronic cases, for mass health education and maintenance of health records, has also been ignored.

Probably the only bright spot in these surveys is the incidence of blindness. Even though the eyes of over 70 per cent of the people were affected, and thousands were initially expected to go blind, ICMR surveys had not found any case of total blindness until the end of March. However there were still thousands with serious eye problems needing urgent treatment and ICMR was still stressing the need for careful follow-studies to monitor any late effects that might occur.

For those who wanted to claim relief in the name of dead relatives, the procedures were frighteningly labyrinthine. The deputy collectors appointed for this work demanded documents. When hospitals were approached, doctors were rude. They considered everyone asking for a death certificate a scoundrel out to make money. Hard-working, proud people who had lost their nearest kin, felt hurt and angry. Even worse, they were made to run around. Looking through thousands of names needed time and hospitals made people come again and again. Those who were too shocked to ask for documents when their nearest were dying now had to go to their local municipal councillors who had been authorised to countersign compensation claim forms and send them to the police for further investigations.

Equally disorganised and lackadaisical was the government's handling of free distribution of milk and rations. Apart from the 1,000 litres of free milk being given out daily the government had announced in December that all families in the affected areas of the city would be given 3 kg of wheat and rice per unit, on their ration card, for December. After the protests in the city, the benefit was extended to January, increased to 12 kg a unit, and for all slum dwellers of the city bcause of the severe dislocation in city life over the previous month. But the government did nothing to ensure proper logistics. Nearly 21,000 temporary ration cards had to be made almost overnight for residents who had none. No extra staff was appointed for making ration cards and the existing ration shops were expected to distribute these extra rations. The chaos that resulted is obvious. The Bhopal tragedy has amply shown that it would be futile to expect the government to deal with such emergencies with any measure of efficiency. And yet high-risk industrialisation has made this an imperative.

**Gas victims protest official callousness towards relief. (Gopal Jain/Times of India)**

## The Legal Battle

The question of compensation has taken the world by a storm. The Bhopal litigation has the potential to become the largest and most lucrative civil legal case in the history of the world. Four days after the tragedy, an American lawyer told the Wall Street Journal, "I will bet that half the top personnel in jury lawyers in America are on planes to New Delhi." Indeed, within a week, American lawyers started arriving in droves to sign up clients. Because of the dream sums they promised, people in Bhopal even queued up in the earlier stages.

When criticised in the Western press that they were just "jet-set ambulance chasers", Melvin Belli, the most famous of them replied: "I'd rather be an ambulance chaser than a coffin maker. These other people caused the accident. We are trying to get some compensation." Soon Union Carbide was facing over 60 lawsuits totalling over $100 billion on behalf of 148,000 victims.

However, none of this has impressed many Indians or the government. The mood in India soon began to turn against the American lawyers and their Indian touts. A random sample of retainership agreements collected by an Indian reporter found that many lawyers intended to take a cut of 60 per cent of the damages as against the normal US practice of 30 to 40 per cent. Certain contracts, such as the one of Belli, did not even specify the contingency fees. Many people who had signed lawyers' forms in English, had not been told what they were signing nor given a receipt. Some lawyers had also taken away hospital and death certificates. Now these people have no papers to prove that they were affected by the gas tragedy. These people also have no information about who they have hired or what is the address of their lawyer.

The state government soon began to grow restive and urged the people not to enter into individual agreements with foreign lawyers. The government opened legal aid and guidance camps in Bhopal. Forms for filing damage suits against the company were supplied. The forms authorised the state government to file suits on behalf of individuals. Every day there were announcements of how many suits were filed in Indian courts. Promises were made to waive court fees and even to set up special courts.

But as time went by, the government became more interested in taking the case to the US court itself. The Union law minister declared the government did "not want the tragedy to be exploited by foreign lawyers". The Union government would "use all channels, even diplomatic ones, if necessary, to ensure that the sufferers are suitably compensated." In early January, the attorney general was sent to the US to consult American courts.

In March, the government pushed the Bhopal Gas Leak Disaster and Processing of Claims Act through the Parliament seeking an exclusive right to represent the Bhopal victims in Indian courts and abroad. Finally, after much dithering and widespread concern that the government may enter into an out-of-court settlement with Carbide, the government filed a petition for unspecified damages in the New York Federal Court in April. The judge hearing the cases collectively ordered Carbide to prepare an interim relief plan by early May—as a matter of "fundamental human decency"—and Carbide in turn announced a $5 million emergency aid to the Bhopal victims.

Seeking compensation in the US courts has become a matter of hot debate in India. Those in favour list a number of advantages. Firstly, the liability will depend upon proof of negligence in India. In the US, the doctrine of strict liability—the fact that injury has been caused is the proof of negligence—is well accepted. A person who chooses to store a dangerous material is also liable for the consequences of the storage. Secondly, if damages are awarded, recovery could be easier in the US. Indian courts can only pass a decree against the Indian company, whose assets will be limited. This would also mean that compensation will be paid by Indian insurance companies for the ills of a US company. Thirdly, the case may drag on for years in Indian courts. There are over one million cases pending in the High Courts and over 1.5 lakh in the Supreme Court. Litigation at the trial court will last for at least

five years. In almost all High Courts, the normal period of pending cases of civil litigations is six to ten years and in the Supreme Court 15 years. US lawyers point out that once the Federal Court in the US decides the question of jurisdiction in favour of the claimants, the insurance companies and UCC will seek a settlement. Fourthly, US courts can award punitive damages, while in India such a concept has yet to be established. Moreover, claimants will not have to spend any advance money towards US lawyers' expenses or fees. US courts allow contingency agreements with lawyers. Court fees in India are high and could prevent many people from filing suits. A claim of Rs 1 lakh will attract a court fee of Rs 7500 and lawyer's fees could amount to Rs 10,000.

US lawyers have also argued that the chances of the case being accepted by a US court are good. UCIL's operations are controlled by the parent company in USA. UCC has been publicly distancing itself from UCIL in an attempt to confine liability to the latter. It has been emphasising that the plant was managed by Indians. But the US courts may not be persuaded by UCC's arguments because the specifications of the plant, the operating procedures and safety guidelines—all substantial decisions—were laid down by UCC headquarters in the US.

Even if jurisdiction of US courts is established, there is the doctrine of forum non convenience, according to which a case should be heard where it is most convenient. Again, recent case law may go against UCC. A US Supreme Court opinion—in a case involving an airplane crash in Scotland—suggests that an important factor will be whether the victims can obtain meaningful relief in the Indian court system. Victim's lawyers could argue that a meaningful forum may not be available in India. The defendent is an American corporation and may not be subject to Indian jurisdiction. Indian law requires plaintiffs to post prohibitively large court fees in advance. Indian courts have a heavy backlog of cases. In other words, the Indian legal system is poorly equipped for mass tort (wrong doing) litigation and is so slow and costly that it deprives poor victims of meaningful relief.

So widely accepted is the US courts option that even the Chief Justice of India, Y.V. Chandrachud, has been quoted by the 'Wall Street Journal' as saying: "It is my opinion that these cases must be pursued in the US. It is the only hope these unfortunate people have." The chief justice even criticised the petition of M.K. Ramamurthy seeking directions to the Madhya Pradesh government and UCIL to pay Rs 5 lakh to the next of kin of each victim as an interim measure. He described it is "bare of facts" and "a casual petition thrown at the courts". The attorney general even argued that by raising the issue of negligence of the state government, the petitioners were playing into the hands of multinational corporations.

But many Indian lawyers remain unconvinced that simply going to US courts will open up US level compensation for Bhopal's victims. Punitive damages is still a largely uncharted area even in the US. Juries in the first stages of trial have often made very generous awards, but they have been invariably whittled down by appeal courts. Thus, even if the jury in the initial trial decides that Bhopal victims should be awarded as if they were living in America, appeal courts may scale down the award. And even after this, the victims could get cheated. In the case of an asbestos factory where the courts had taken the paying capacity of a corporation into account and awarded payment of $1,00,000 to each affected worker, they were outwitted by the manufacturer who took shelter behind bankruptcy laws. The victims could thus collect only as much as the liquidated assets of the company could accomodate. There are few cases in which punitive damages awarded by juries in the initial trial have actually reached the plaintiffs.

Indira Jaising of the Lawyers' Collective in Bombay has described the government's decision to go to a court in the US as a mockery of India's sovereignty. "There is no law which prevents Indian courts granting adequate compensation and punitive damages," says Jaising. "If Indian courts have been awarding abysmally small amounts as compensation, it is because their sensitivity to the value of life is dimmed." Instead of taking the Bhopal disaster as an opportunity to advance the legal system in India, Jaising argues that we have the "shameful spectacle of a sovereign nation-state, one of whose prime prerogatives it is to dispense justice, asking for justice from the white man." If tomorrow the disaster occurs in a public sector company, where will Indians then run to?

Several commentators have argued that by going to US courts the government is trying to divert attention from its own criminally negligent role in permitting Carbide to be lax with its safety measures. The act permitting the government exclusive right to represent the Bhopal victims, has since been challenged in the Supreme Court as denying people's fundamental rights. Leading lawyers have asked how the government, a party to the crime, can suddenly become the guardian for the victims of the crime. The government cannot pursue litigation in the US on the condition that victims must give up their claims against the local authorities, as is alleged to be the government's scheme.

K.N. Goyal, a sitting judge of the Allahabad High Court, has argued that victims should not get carried away by the mirage of astronomical damages through US courts, and allow suits in Indian courts to get time barred. Even in India relatives of each dead person could get damages between Rs 2.5 lakh to Rs 3.5 lakh. Adds Goyal: "The government officials who were responsible for ensuring compliance (and who) allowed such neglect or breach to take place also need to be punished through suitable disciplinary or criminal proceedings or both."

P.M. Bakshi, a member of the Law Commission, has pleaded for immediate legal reforms that would facilitate class action suits in India to provide adequate redress for mass accidents. Former Supreme Court judge, V.R. Krishna Iyer has suggested the enactment of a substantive law of torts, new laws creating strict liability and for standardising compensation for mass application, and the institution of a new division in the High Court called the Environment Division, which has an adequate number of judges, who have gone through courses on environmental law.

But little of all this seems to be happening. Many voluntary groups fear that the government will sooner or later enter into an out-of-court agreement with Carbide. The government has dismissed Carbides earlier offer of $200 million spread over 38 annual instalments as insignificant and frivolous but the minister of chemicals and fertilisers has not ruled out an out of court settlement. The 'Wall Street Journal' has claimed that the Indian government may settle for $ 500 million. American lawyers, who have filed suits against Carbide, have also expressed fears that the Indian government "may settle too cheaply".

While the US press described the Indian government's decision to file a suit against Carbide as a setback to the company, which was hoping for a speedy settlement, Carbide's chief Warren Anderson has announced he is ready to meet Prime Minister Rajiv Gandhi to sort out the compensation issue. But he also criticised the Indian government for calling the company's offer too low without giving any reason for raising it. The legal claims of Bhopal's victims, thus, remain open even five months after the disaster and all the world's systems of justice have not been able to bring to book those responsible for mass murder.

## Issues after Bhopal

The Bhopal disaster has raised a series of questions: Where have other hazardous plants been built in India? Why were so many people living so close to the plant in Bhopal? How do we develop a policy for siting hazardous factories? Do adequate health and safety laws exist, which might prevent the occurrence of another disaster? Is it true that the benefits of using pesticides are so great that its costs in human lives are outweighed by the lives saved by pesticide use? Do multinationals operate with lower standards for health and safety in their Third World plants than in their home country? Underlying these are deeper issues, about the controls that should govern the industrialisation process, about who decides, whose needs are met by industrialisation, and how multinational corporations, in particular, can be held accountable.

Indian newspaper editorials and articles, especially the big English language newspapers, have largely demanded legal controls and regulations. They have pointed out the inadequacies of the air and water pollution control laws, laws like the Factories Act which are supposed to control occupational health problems and oversee safety measures, and laws meant to regulate the use of pesticides. A carefully screened register of hazardous chemicals and industries is needed. In France, all companies and installations which can pose a danger to the environment have to get themselves registered by law. Stronger laws together with stricter implementation have been demanded almost uniformly.

Considerable attention has also been given to the siting of hazardous industries. Western commentators have repeatedly asked why were so many people allowed to live so close to the hazardous plant. The area was uninhabited when the plant was built. Most Indian editorial writers also recommended that hazardous industries be set up far away from populated areas. The Central Board for the Prevention and Control of Water and Air Pollution has recommended uninhabited green belts 2-3 km in all directions around hazardous industries. One newspaper writer suggested that this 12-30 sq km green area could "either be sold to the concerned companies at a low rate (for experimental farms, etc) or be kept with the state/local government". As far as slums which already exist around hazardous industries, it has been demanded that they be removed forthwith. This view that people, not industries, need to be removed has been echoed by numerous industrialists since the disaster.

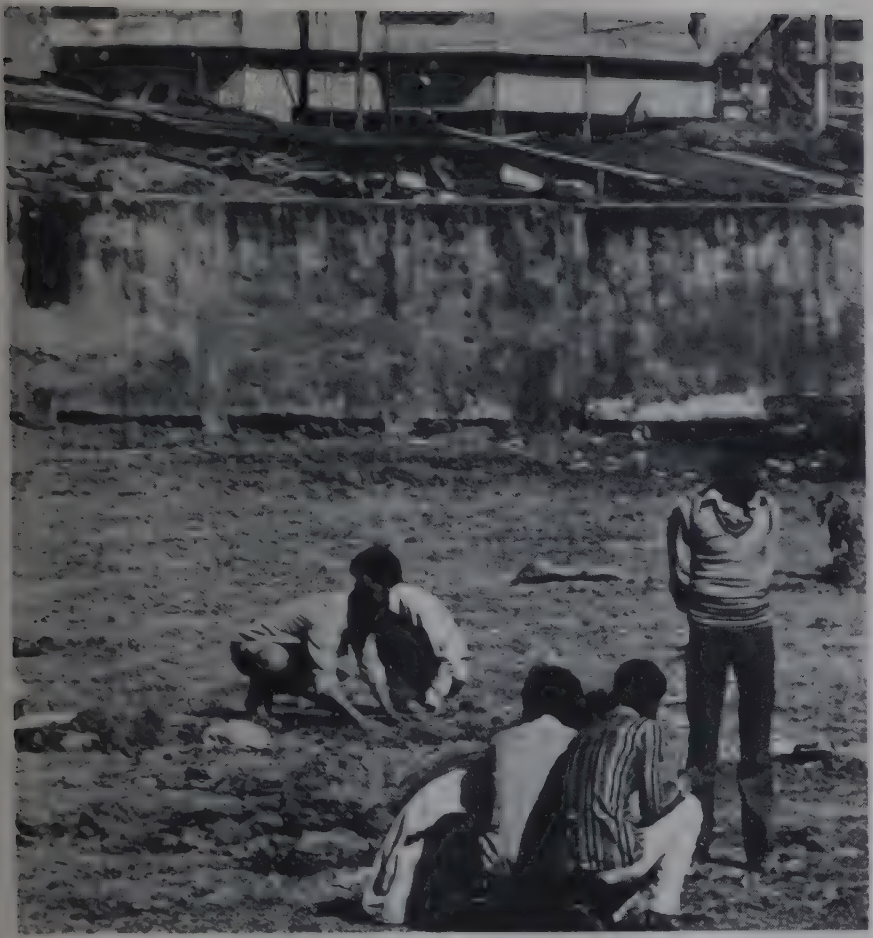
A third point concerns imported chemicals. A number of pesticides and drugs banned or heavily restricted elsewhere are being knowingly imported or manufactured in India. An example is polychlorinated biphenyls (PCBs), used in electrical capacitors and transformers. PCBs have been banned in most developed countries because they produce cancer. In many small-scale industries where these chemicals are used, workers are not even conscious of the danger.

The fourth point made is about the choice of technology. For instance, many companies manufacture carbaryl without using MIC and, indeed, Union Carbide itself switched to using MIC only a decade before the Bhopal plant was licensed. Industrial licensing authorities made no attempt to assess the advantages of the alternative route in Indian conditions. They seem to have been carried away with Carbide's offer to bring the latest technology. On the contrary, France refused to allow MIC to be produced. A caprolactam plant has recently been set up on the outskirts of a south Indian city. This plant uses the same hazardous process used at Flixborough in UK, which suffered one of the worst fires known to chemical industry in 1974, when cyclohexane vapour was released. A safer alternative process could have been used.

Parents burying dead children outside the killer Carbide plant. (N. Thiagarajan/Hindustan Times)

A fifth point relates to the transportation of toxic chemicals. MIC was being transported from Bhopal to several locations in India without any regulations. Nearly 100 accidents involving the release of toxic chemicals during rail transport occur in the US every year. Two accidents on an average involve damages of over a million dollars. Since Bhopal, many local communities and states in the US have begun passing restrictions regarding transport of substances like MIC. They have refused to wait for adequate federal regulations.

A sixth point takes in the behaviour of multinational corporations, which have repeatedly exported banned drugs and pesticides and even entire factories to the Third World. Asbestos is today the largest single cause of occupational cancer in the US , and experts have calculated that 8000 to 10,000 Americans will die annually over the next 20 years because of exposure to asbestos in the past. Use of asbestos in industrial nations has declined precipitously—in Britain, by 52 per cent between 1975 and 1982 and in the US, by 60 per cent from 1978. Sweden has virtually eliminated the use of asbestos, the result of a trade union campaign since 1975. But in the Third World, the use of asbestos-cement materials is growing. In Ahmedabad, Shree Digvijay Cement produces 50,000 tonnes of asbestos-cement pipes and sheets per year. Its foreign collaborator, John Manville Corporation, was so heavily sued in the US that it took



**Industrialisation is creating a high-risk environment but emergency response systems needed to deal with it are missing. Even trucks ran out of space transporting bodies in Bhopal.**

refuge under bankruptcy laws. In Bombay, Hindustan Ferrodo, in collaboration with the British company, Turner and Newall, manufactures asbestos textiles and brake linings, which are being abandoned in Europe and USA. No attempt has been made by these companies to inform Indian workers or consumers of the dangers of asbestos.

All these suggestions pose serious problems. Take, for instance, the idea of siting hazardous industries away from human habitation. Zoning is relatively successful in Western countries, where an affluent population has access to efficient transport facilities. By contrast, a sizeable fraction of India's urban population cannot afford even subsidised public transport system. Moreover, Western cities have never faced the kind of rapid growth that Third World cities face today. Slums come up where work opportunities exist, and usually at such a speed that urban planners find them extremely difficult to control. Industrialisation and urbanisation go hand in hand. Industries immediately become focal points for urban growth and accretion of settlements. In fact, many chemical plants even in the United States, are situated in crowded urban areas, in particular older plants, which came up during the Second World War and before. Union Carbide's other MIC-producing plant at Institute,West Virginia, is a prime example.

Only an extremely strict regulatory regime, which could easily acquire an extremely oppressive character, with slums being regularly bulldozed would work. A zoning policy would work properly only if the government could develop an overall policy for housing all urban residents. Otherwise the urban planners' 'unintended city' will invade all regulated zones. At a time, when slums are growing in most Indian cities, such a policy looks like a dream. Only a few months before the disaster, the residents of J.P. Nagar had received 'pattas' (ownership rights) for their house-sites. The most precious thing with which they ran, when the gas wafted into their houses, was the patta.

A siting policy which pushes hazardous industries into 'backward' rural area could easily become an excuse for displacing rural people. Workers in remotely located plants will also need transport facilities. Unless Indians want to blame the victims for the suffering caused by such disaster, the country must realise that, it has only two options for hazardous industries: either such industries are not built at all by adopting suitable technology or lifestyle choices, or if they have to be built, they will have to live cheek by jowl with people (especially poor people), in which case safety measures must override all considerations, including economic considerations. And to ensure that safety measures are indeed undertaken, the people must be fully involved and informed about all possible dangers.

Indian social action groups have strongly argued for the people's right to know about hazardous factories, where they are being sited, why and what dangers they pose. Only when people know will there be public pressures for safety and a honest response from regulators. The callousness with which the warnings about the Bhopal plant were ignored shows an unholy politician-industrialists nexus operating in full bloom. As Prem Shankar Jha of the 'Times of India' put it, industrialisation cannot proceed without Bhopal-type disasters, unless there is political discipline—and greater democracy. Without political discipline, multinationals, too, cannot be adequately policed.

In the US, questions are being raised about who decides where hazardous plants are sited. Should this only be a matter of concern to industrialists and government regulators, or should the people also have a full legal right to intervene? Equally, shouldn't a plant's neighbours have the right to intervene when a production line is changed from a relatively non-hazardous one into a hazardous one? Such questions are now being asked loudly in Kanawha Valley, where Carbide's Institute plant is located.

A prime example of a government regulation failing to control hazardous substances, in the absence of public pressure, is the Insecticides Act. The act is enforced by the very agency—the Ministry of Agriculture—that is promoting chemical agriculture and only public-spirited environmentalists can put pressure on the regulating agency to observe the spirit of the act. In the US, too, the Federal Insecticides, Fungicide and Rodenticide Act enacted in 1947 did little to control dangerous pesticides until Rachel Carson's celebrated book, 'Silent Spring', created an international furore.

The right to know is particularly important in a society like India where most producers of scientific knowledge work for the government or the corporate sector, both of which close information to the public, expecially in adverse circumstances. Said D. Banerji, community health expert of the Jawaharlal Nehru University, "The Bhopal tragedy has exposed the most deplorable state of the community of scientists of India." Scientific institutions in the developing world have developed mainly under government auspices.

Excessive government control has led to a political and bureaucratic stranglehold over information. Secrecy reached incredible levels in Bhopal after the disaster. Even the Indian Meteorological Department, the government's

## One Down, More to Go

The Bhopal disaster has at least spurred some state pollution control boards into action. In two states — Maharashtra and West Bengal — and the Union Territory of Delhi, surveys of hazardous industries have been undertaken, generating the country's first inventory of hazardous industries. The most interesting thing about these surveys is that they indict the country's blue chip companies of gross environmental negligence and unsafe practices.

The West Bengal Pollution Control Board survey found 55 hazardous industries in Calcutta, six in Howrah and another 20-odd in other districts. In this list were such leading companies as Chloride India, Bata India, Kesoram Rayon, Bengal Chemicals, Titagarh Paper Mills, Reckit and Coleman, Calcutta Chemicals, Shalimar Paints, Guest Keen William, Hindustan Motors, Standard Pharmaceuticals, Wimco, Bengal Distilleries and East India Paper. All these companies were found releasing hazardous effluents into rivers and sewers. At Chloride India's Shyamnagar plant, for instance, the lead in the effluents was 0.4 ppm as compared to the board's stipulation of 0.1 ppm. Bata India's effluents contained chromium and of Kesoram Rayon's contained zinc. The board had taken legal action only against five companies and the majority of even the known offenders had gone free.

In Delhi, the administration surveyed 109 companies and found two in particular with safety deficiencies: Shriram Foods and Fertilisers and Hindustan Insecticides. The administration also announced the setting up of a special cell to monitor safety measures in these 109 companies, so that these factory inspectors would not get bogged down with routine inspections. One factory was found storing 100 tonnes of chlorine and, if safety precautions slackened, a Bhopal could easily repeat itself.

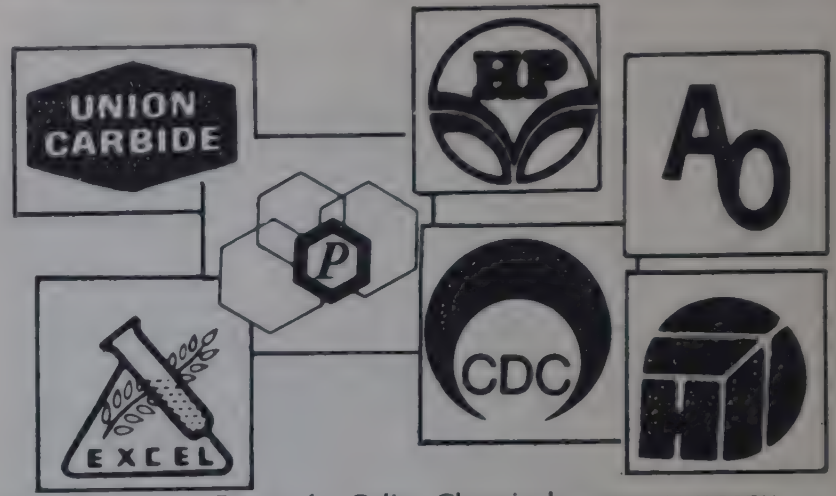
In Bombay, the post-Bhopal days were even dubbed the "chemical scare season" by one magazine. For a fortnight beginning March 3, Bombay's civic authorities were besieged with phone calls from anxious citizens alarmed at obnoxious smells, which they suspected to be leaks from chemical plants. The sources of most of the leaks could not be traced. In one case, the Bombay Municipal Corporation and the Maharashtra Pollution Control Board took ten days to find an ammonia leak source: the Boots (India) plant in Sion. By that time the company had repaired the damage.

On March 12, gas leaked from the ammonia loading station of the Rashtriya Chemicals and Fertilisers (RCF) plant at Chembur. Air samples taken on the night of the leak revealed that the ammonia concentration in the air was well above the threshold limit (TLV). Then it was found that ammonia had leaked a day before too. Finally, on March 14, the MPCB ordered the plant closed until repairs were completed. The plant came back into operation a few days later.

Again on April 1, a two metre long crack in a pipe in the RCF sulphuric acid plant sent sulphuric acid fumes and sulphur dioxide into the air. The acid fumes dispersed in 15 minutes after the plant was shutdown. But only after a bout of widespread choking, workers running helter skelter, slum dwellers residing near the plant fleeing from their hutments, and other residents refusing to open their windows for long. RCF chairperson was at the time of the leak giving a lecture on industrial pollution, in which he blamed poor work ethics, infrastructural deficiencies, low maintenance standards, and unreliable testing systems. The company's union, however, blamed the management for not having repaired the pipe properly when it had leaked the first time.

In April, the MPCB also released its report on Bombay's hazardous industries. Over half of the 6000 polluting industries identified in the state are located in and around Bombay. This figure does not include the thousands that operate illegally. There are around 50 giant sized companies in Bombay, which handle or manufacture hazardous chemicals, including MIC.

The Environmental Safety Committee set up by the MPCB under R.K. Garg of the Bhabha Atomic Research Centre surveyed 15 major industrial units. Its report was definitely sobering. Almost every factory it inspected was deficient in safety measures. Except for Calico Chemicals, every company was making good profits consistently and there was no shortage of funds.



The committee reported a series of deficiencies in the RCF, Chembur factory. It found that shop floor operators were not conversant with safety devices and procedures for handling abnormal operational problems. There was no system for continuous monitoring of hazardous chemicals like ammonia, carbon monoxide and nitrogen dioxide. A number of safety valves and level and pressure indicators were found to be corroded. The committee was promised that steps would be undertaken to rectify this situation.

The styrene monomer plant of Polychem Ltd in Chembur handles a variety of hazardous chemicals in bulk including alcohol, benzene, ethylbenzene and ethylene, which are also highly inflammable. But the company had no firefighting group, nor a safety officer. The committee was also concerned by the inadequate water supply arrangements for firefighting purposes. The workers were not checked periodically for benzene or styrene exposure. Workers were also exposed to anhydrous aluminium chloride, which they had to feed into the chemical reactor manually.

The Calico Chemicals plant at Chembur was found to be a particularly hazardous place. The plant handles a range of inflammable materials and highly carcinogenic substances like vinyl chloride. The entire safety aspect, including disaster planning, needed a thorough review. The valves, pipelines and storage vessels of the chlorine and caustic soda plant were found to be in such a highly corroded state that the plant was not even safe enough to be operated in its present condition. Workers in the chlorine handling plant had not been given proper masks, emergency kits or breathing apparatus. The vent lines from the hydrochloric acid storage tank did not pass through a scrubbing system, as safety regulations demand. The company also maintained a highly dangerous quantity of vinyl chloride which, according to the committee, should be restricted to a maximum of one day's requirement. It was also found that, in the case of a runaway reaction, the highly carcinogenic vinyl chloride was blown into the atmosphere in the obsolete PVC plant. Mercury leakage was not monitored, nor were workers checked regularly for exposure to mercury and vinyl chloride. The effluent treatment facility was also not adequate and did not operate regularly.

The Carbide Chemicals plant in Chembur both uses and produces a range of highly toxic and inflammable chemicals. In 1979, an expansion programme increased the company's polyethylene production capacity from 9,000 tonnes to 20,000 tonnes. Although the company has a safety officer and a fire-fighting group, the committee claimed that, "it is not well equipped to cope with a disaster". The workers were not provided with clear instructions for what to do in case of an emergency. The treatment plant was inadequate. Levels of BOD, COD and chlorine in the effluent water were excessive. The vent line from the crotonaldehyde storage tank was left open to the surrounding atmosphere. The committee felt that the company was storing dangerous amounts of this chemical and recommended that it be limited to a maximum amount of process requirements of 8 hours. Before shutdown of the plant for repairs and maintenance, it should be ensured that all crotonaldehyde is consumed. There was no monitoring arrangements for toxic chemicals like crotonaldehyde and benzene in the atmosphere and fire-fighting arrangements were also inadequate.

The Hindustan Petroleum plant at Chembur has a crude oil processing capacity of five million tonnes a year. The plant emits 36 tonnes of sulphur dioxide and 76 tonnes of carbon monoxide every day. The committee felt that not only should these emissions be monitored regularly, but they should also be reduced as they are inordinately high. The oleum storage tank opened out into the atmosphere without an absorbtion system and there was no dike wall to prevent the spreading of the acid in case of leakage. Leakage of phenol in the coolant water was also not being monitored adequately.

The Bharat Petroleum Corporation refinery at Chembur processes another 6 million tonnes of crude oil every year. Apart from 3.5 million tonnes of crude oil, which are stored at any given time in the refinery, constituting the biggest fire hazard in the area, the natural gas and petroleum products that are produced here are all highly inflammable. The committee found that the refinery's wastewater treatment plant was not functioning to the mark and both sulphur dioxide and carbon monoxide emissions to the atmosphere were very high. Air and water discharges and their sources were not being regularly monitored for pollutant levels. The scrubber vent on the tetraethyl lead storage tank was also inadequate.

The five electricity generating units of the Tata Electric Company (837.5 mw total) are located in the congested Trombay area. This company accounts for nearly 70 per cent of the nitric oxide released in Chembur. Neither the releases of sulphur dioxide and nitric oxide nor the temperature of the wastewater at the discharge point were being monitored continuously.

The Ahmed Oil Mills situated in the densely populated and residential Grant Road area produces hundred tonnes of edible oil every day. The BOD in the effluent water and the sulphur dioxide emissions to the atmosphere were very high. There was so system for monitoring the plant's effluents. It did not have an effluent treatment plant either. There was no safety training for the workers, nor was there a fire and safety officer. Hydrogen has been stored in a partially open, congested place and no permission had been taken from the explosive department. The company did not have any provision for control of ammonia in case of leakage.

The Bombay Soap Factory, situated next to the Ahmed Oil Mills, also has no effluent treatment plant, despite being located in a densely populated area. The BOD, COD and chlorine levels in the effluent water were very high compared to the set standards. There was no separate fire-fighting group. The committee noted that the company has a casual approach to safety aspects. Hexane, a dangerous chemical, was stored in large amounts even when the plant was not in operation and the storage area was not properly segregated. The committee recommended that the plant be shifted to a suitable area immediately.

The Hindustan Lever plant at Sewri manufactures various detergent bars, talcum powder, soaps and vanaspati. This company also handles a number of toxic and inflammable chemicals. The committee told the company that it should immediately discontinue its practice of storing monoethanolamine, a highly toxic chemical, in large quantities in drums near the plant. The COD in the effluent water was also higher than the stipulated standard. The emissions from the plant were being monitored only once a quarter. The company was also told not to transport the toxic sludge from the wastewater treatment plant by road, as this was dangerous. Transport by sea was recommended.

HINDUSTAN
CIBA-GEIGY
LIMITED

calico

Excel Industries Ltd has two plants in Bombay at Amboli and Jogeshwari. It manufactures industrial and agricultural chemicals used as basic chemicals and intermediates in industry and as pesticides and fumigants. Neither of the plants had a separate safety and fire officer as required by safety regulations. The oxalic acid plant at Jogeshwari did not have any standby caustic soda scrubber for nitric oxide. Nor did it have an alarm system to indicate release of excess nitric oxide fumes. The incidence of nitric oxide was very high in the mercuric chloride plant. The flooring of the plant was not proper for collecting any spillage of mercury. The mercury release in the effluent was slightly higher than the standard. Mercury level in the urine of the workers was not being monitored. The committee found that in the Amboli plant, yellow phosphorus drums were being stored in a dangerous manner. The stacks of aluminium phosphate and zinc phosphide plants were not monitored periodically for toxic compounds, nor was the percentage of arsenic in zinc dust checked. The workers were not periodically checked for benzene exposure.

The dyes and chemical plant of India Explosives Ltd in Sewri came in for harsh criticism from the committee. There was no monitoring of emissions and no proper effluent treatment plant had been provided. They was a casual approach in safety measures while handling hazardous chemicals. There was no fire-fighting group available round the clock. Butanol was being stored near the cyanide handling unit, which is highly dangerous. The committee suggested a number of changes in the storage practices of various chemicals and recommended proper level indicators, vents and scrubbers for all storage tanks. It also recommended that cyanide emissions should be monitored and workers should undergo regular medical checks. The committee passed the following verdict: "In view of the improper storage facilities of hazardous chemicals, absence of proper monitoring system for effluents and emissions, and low levels of awareness of safety measures, the committee feels that it is not safe to operate the plant."

Wellcome

RCF

TATA ELECTRIC

The Burroughs Wellcome plant in Mulund, which manufactures medicines, was found storing highly dangerous and inflammable substances including hydrogen, phosgene and sulphur dioxide. Many of the chemicals and solvents were stored in the open and close to each other. The committee felt the excessive storing of these chemicals should be stopped immediately. The pipe from the phosgene reactor to the scrubber was made of glass, which is fragile, and constitutes a potential hazard. The monitoring of phosgene and chlorine in the working areas was not being carried out with proper instruments. The COD and BOD levels in the effluent waters were also high.

The Hindustan Ciba Geigy plant at Bhandup manufactures several consumer products, dyes and chemicals. The emissions from the plant were not being monitored and there was no temperature measurement system for chloroform in the storage tank. The chloroform tank itself needed to be relocated away from the railway line. The vent of the toluene storage tank was left open to the atmosphere. Acids and various chemicals were being stored together.

From what the committee found it is indeed surprising that Bhopal doesn't take place every day in Bombay. To what extent its recommendations will now be followed is still not clear. When asked whether chemical plants should maintain only those amounts of chemicals which can be used up in one day, as recommended by the Garg committee, RCF's Chairperson Duleep Singh said, "I appreciate the Garg committee's recommendations, but they are a little in the extreme. No factory would keep only a day's inventory as this would prove uneconomical."

**Zoning has been unsuccessful in India. Bhopal's slum dwellers ran for their lives but with their pattas. (Ashok Chaddha)**

innocuous weather agency, refused to divulge information about the weather conditions on that fateful night. The Madhya Pradesh health department has consciously sought to suppress all information relating to the health of the victims, forcing voluntary agencies to take up public interest research and epidemiological surveys. For the public it has been almost impossible to sort out the truth from the lies — especially the technical and medical lies — whether they have been trotted out by the company or the government.

The Bhopal disaster has thus, reinforced the need—and demand—to democratise access to information. It is clear that otherwise every interest group will try to exploit the society's ignorance for its own nefarious ends. Only alert citizen's action groups, armed with legal rights like the right to know and with institutions involved in public interest research, can bring order to an otherwise increasingly chaotic industrial safety situation. The Society for Participatory Research in Asia has suggested that industrial workers' trade unions should take the lead by setting up independent research groups on occupational health and industrial safety. Even in the US, with all its technological capabilities, and advanced government regulations, active citizens' groups alone were getting laws implemented and action taken.

**Pattern of industrialisation**

Several commentators have also raised broader questions about the very pattern of industrialisation, which generates such a massive demand for toxic substances and which exposes the poor to such hazards?

Western newspapers have quickly reminded the Third World about 'a balance sheet of death' as the 'Guardian' in London put it, or 'The Pain of Progress', as the New York Times' put it. Said the pro-industry Wall Street Journal: "Of the people killed, half would not have been alive if it were not for that plant and the modern health standards made possible by the use of pesticides." The British science magazine, 'New Scientist', has been equally pointed in its remarks: " Rich nations can afford to forego a little pesticide for fear of spreading a rare cancer. Such arguments mean little in countries where thousands die from hunger." Thus, if pesticides kill, they also save.

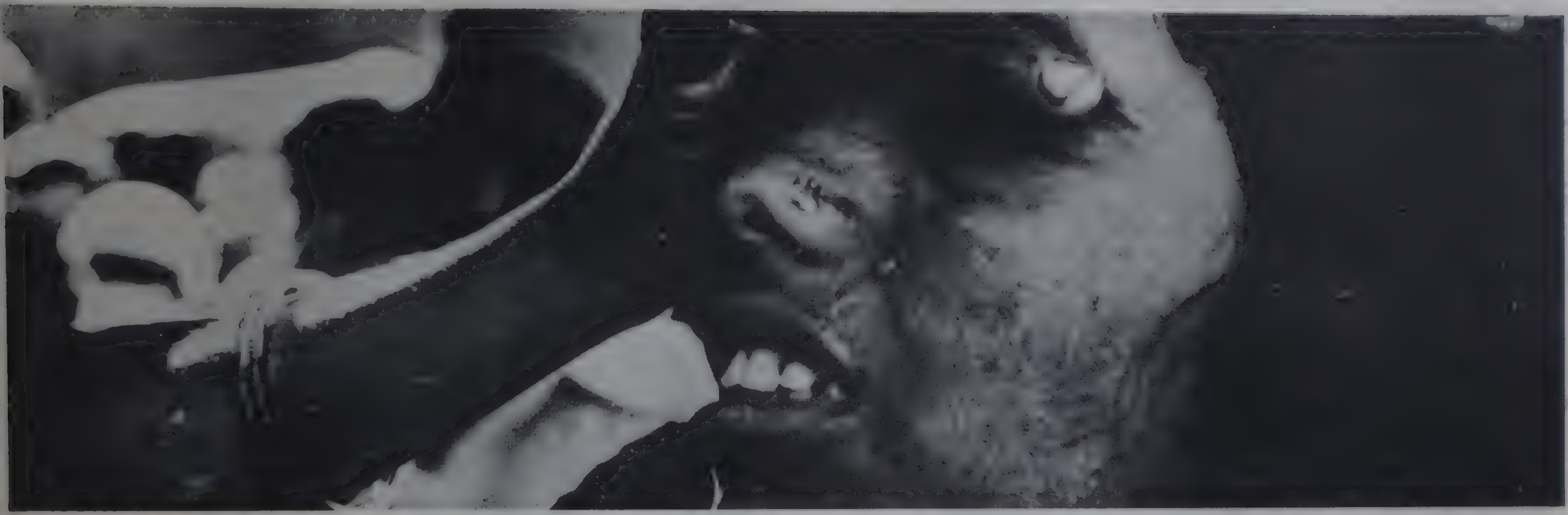
In any case, many multinational executives have asked, why should developed countries be responsible for controls on products used by developing countries? Wouldn't that be a kind of 'environmental imperialism'? James Weeks, a commentators in consumer crusaders, Ralph Nader's Multinational Monitor has argued back "This concern obscures a more fundamental issue: the dictating that is already being done by an international economic system dominated by the same multinationals." In 1981, President Ronald Reagan overturned an executive order by former President James Carter to inform developing countries about export of products banned in the US, because it could affect US exports.

India's ruling elite probably, believes in the 'balance sheet of death' argument. Commenting on the fact that hardly any English newspaper had criticised the industrialisation process itself, one Hindi poetess lamented: "there was no anger in any of the newspapers."

There were indeed only a few exceptions. Said Prabhash Joshi, the editor of Jansatta: "The benefits of 21st century technology will go to politicians, administrators, scientists and so-called intellectuals. But the people who have to pay the price of this technology with their lives, are those who cannot even get enough to eat two times a day. Borrowed technology from the West cannot fill the gap between these two worlds. This gulf is beyond the understanding and resolution power of the West."

The Zahreeli Gas Kand Sangarsh Morcha and several voluntary groups across the country have demanded an alternative development process, which will be based not only on appropriate technological choices, but also on appropriate lifestyle choices. There is no particular reason, for instance, why there should be such a demand for plastics, detergents or polyurethane foam. The demand for these products has arisen out of aggressive marketing policies, whose sole interest is to increase corporate profits.

In agriculture, too, there is no real need to rely heavily on pesticides. While insecticide use has increased 11-fold over the past 30 years, crop losses due to insect resistance doubled. Through land reforms, soil conservation measures, building of small water harvesting systems like tanks and ponds, planting of multipurpose food, fuel and fodder tree species, intercropping and use of resistant crop varieties, setting up of integrated systems of animal husbandry, crops, orchards and aquaculture, villages can be turned into highly productive, symbiotically-integrated ecosystems of food-fuel-fish-fertiliser-fodder biomass, and the need for chemical fertilisers and pesticides can be

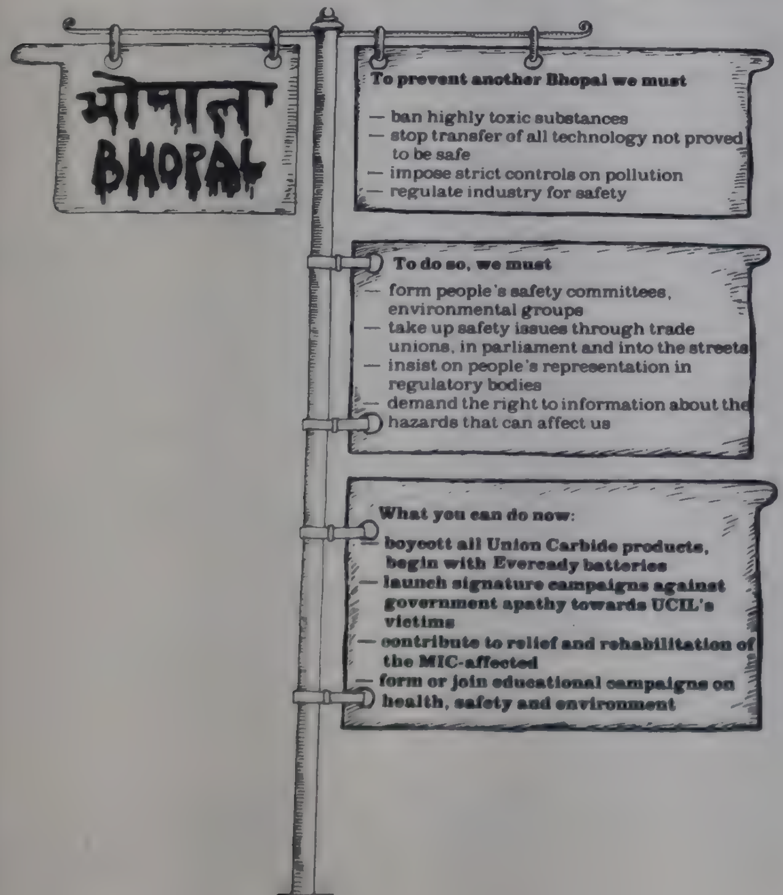


**The Bhopal disaster hit entire families. Their eyes and lungs badly affected, many of them will never to be able to work as manual labourers again.,(N. Thiagarajan/Hindustan Times)**

almost eliminated.

In the area of public health, India's own scientific laboratories have shown that the town of Pondicherry and villages of Gujarat can get rid of mosquitoes by policies that help the people to clean up their environment. What is the value of dumping more and more powerful insecticides while mosquitogenic, filthy conditions are being simultaneously created for mosquito-borne diseases to grow?

But a move away from highly toxic, bulldozing chemicals will require a holistic approach to people's problems and people's participation in the management of national resources and generation of technology. This will come about only, as poet Raghubir Sahay has put it, with a culture of *anusandhan* (research and discovery) and not one of *anukaran* (blind imitation). However, several commentators have been extremely pessimistic about such a culture actually being born. They argue that this culture based on modern technology is so seductive that changing it will be an extremely difficult task. Asked one writer from Bhopal; "we may be able to stop the multinational corporation from coming in but can we stop the 'multinational culture'? Is this not the culture that all of us crave for? As if to prove this point, there was no effect of the Bhopal disaster on the fortunes of the ruling party in the parliamentary elections from Madhya Pradesh. The ruling party also won the seat of Bhopal. Said Rajkumar Keshwani, the journalist who had given warning of the disaster two years before: "I don't see any anger. I only see shattered people. And outside the affected areas, there is only a desire for more of the same."



**To prevent another Bhopal we must**

- ban highly toxic substances
- stop transfer of all technology not proved to be safe
- impose strict controls on pollution
- regulate industry for safety

**To do so, we must**

- form people's safety committees, environmental groups
- take up safety issues through trade unions, in parliament and into the streets
- insist on people's representation in regulatory bodies
- demand the right to information about the hazards that can affect us

**What you can do now:**

- **boycott all Union Carbide products, begin with Eveready batteries**
- **launch signature campaigns against government apathy towards UCIL's victims**
- **contribute to relief and rehabilitation of the MIC-affected**
- **form or join educational campaigns on health, safety and environment**

**(CED)**

Five months later, the government still had not taken any steps to prevent the recurrence of Bhopal-type disasters. A proposal to set up an inter-ministerial board on hazardous chemicals had been quietly buried. The Ministry of Chemicals announced the establishment of a cell, but that too, had not taken off. The Department of Environment was waiting for the Scientific Advisory Committee to the Cabinet to discuss its proposal for a comprehensive Toxic Substances Act. Only some state pollution control boards have started flexing their muscles, basking in all the public attention that they were getting after Bhopal. But what impact their new-found power will have is still not clear.

What is clear, however, is that the government has not even thought of developing any emergency response system to industrial disasters. Industrial disasters involving toxic chemicals occur with frightening regularity even in highly advanced countries like the US but they kill few people because of the highly sophisticated emergency response systems that exist, in which thousands of people can be evacuated within minutes. Industrialisation is creating a high-risk environment everywhere in the world but more so in the Third World where lack of capital, general inefficiency within the bureaucracy, and the callousness towards the underprivileged bred by the dual society, combine to create an unfortunate situation in which it is even ridiculous to expect a sincere, efficient and concerned response to disasters, natural or human-made. Statistics repeatedly show that an average typhoon kills few people in the US as compared to poor Philippines and few in Phillippines as compared to poorer Bangladesh. Indians, caught in the race for industrialisation, can only wonder how a government would ever handle a nuclear disaster. Dealing with it may again be left to the informal sector of social work — the voluntary agencies — and to people to fight for their rights.

# OCCUPATIONAL HAZARDS

For years, the phrase "occupational hazards" conjured up visions of people working in damp, unhealthy mines, and in factories where workers and machines were constantly at war. Only recently has the concept been broadened to embrace less visible but no less dangerous threats like cancers striking even 20 years after exposure to chemicals, dust and fibres in the workplace, noise and even psychological wear and tear. And it is not just in mines and factories that the workers are under attack, but in all types of employment, including mercantile and commercial enterprises, service trades, forestry and agriculture.

According to the United Nations, 180,000 workers die every year throughout the world as a result of accidents and occupational diseases. Another 110 million suffer non-fatal injuries. The concept of occupational health is so new to India and government efforts to improve working conditions so paltry that accurate statistics on worker accidents and occupational health status do not exist.

## Deadly dust

The gravest occupational diseases are caused by dust. These are generically known as pneumoconioses, or lung diseases, and their gravity depends on the type of dust, its fineness, concentration, period of exposure and the victim's health. Specifically, pneumoconiosis refers to a disease caused by inhaling waste dust but it also takes in silicosis (caused by silica dust), asbestosis (asbestos fibres), byssinosis (cotton dust) and so on.

### Silicosis

Silicosis is caused by dust containing free silica or silicon dioxide. It was first reported in India in the Kolar gold mines in 1947, and has since been uncovered in various other mines and industries: coal, mica, silver, lead, zinc and manganese mines and pottery and ceramics, sand blasting, metal grinding, building and construction work, rock mining, iron and steel industry and several others. It is an insidious predator: in Bihar's mica mines, one of three workers suffers from silicosis.

**Byssinosis affects thousands of cotton mill workers, a lung disease caused by inhaling cotton dust. (ILO)**

The slate pencil factories of Mandsaur in Madhya Pradesh are a shocking case in point. There are some 90 slate-pencil cutting units in Mandsaur, Multanpur and Pipalimandi. Multanpur's entire population is employed by the industry. There is hardly a man alive over 40 years old, and hardly a house which doesn't have a widow: many women have remarried only to be widowed again. Children have to work to support their mothers and often succumb to the scourge themselves.

The shale sedimentary rock, large deposits of which are found 10 ft to 30 ft below the surface, is the culprit. Shale blocks are cut into thin plates by an electric saw and further shaped into pencils, which are rounded, sharpened manually and packed into boxes. The hazardous part of the operation is the use of the saw. According to a study of 605 Mandsaur workers in six units conducted by the National Institute of Occupational Health (NIOH) in 1981, "this is a dry process and, during cutting, dust is generated in clouds and pervades the factory atmosphere .... The cutter is at a special risk, principally because the stream of dust arising during cutting is directed towards his face."

The dust is 50 per cent to 55 per cent silica, is breathed in directly and the first symptoms of silicosis, after six months, are coughs and colds. As the dust accumulates in the lungs, the worker gets chest pains and wheezes like an asthmatic, a medical condition called dyspnoea. The NIOH found that 55 per cent of the workers had silicosis, and 18 per cent had an advanced form of the disease. Cutters were understandably the worst affected.

There is no effective treatment and silicosis can only be prevented by rigorous dust control and regular medical examinations, two measures which are almost invariably absent in industries situated in remote areas. So the estimated 5,000 workers in the slate units live hand in hand with death. A local doctor estimates that about 150 persons die every year and over the last 25 years, the disease has taken a toll of no fewer than 3,500 lives. Social activists have supplied a list of 62 people who have died of silicosis and another 75 who have contracted it.

The slate pencil industry offers casual and temporary employment to women and children: one estimate puts the number of children below 12 at 500. These women and children are allowed to take pencils home, where they are given finishing touches and packed. While this augments their meagre income, it also fills their small, poorly ventilated homes with silica dust; even new-born infants are exposed.

The NIOH study reveals the significant fact that half the male workers are below 25, whereas half the female workers are under 37 years old. Half the males have been working for less than seven years: the corresponding period for women is 12 years. It attributes this to the fact that females are never employed as cutters, only in rolling, packing and so on and, unlike men, often take their work home and escape prolonged exposure.

Horror stories abound. Nanuram Teli, a 70-year-old resident of Mandsaur, is blind, deaf and dumb. He has lost his four sons—Raghunath, 40, Bamchand, 35, Daya Ram, 32 and Kishimal, 30. In the nearby village of Ryalta, Bharu

**When stonecrushers are in operation, visibility drops to a few feet and workers regularly inhale stone dust. (Anil Agarwal)**

Bhami has lost four brothers. But the workers are in a terrible bind, the industry is the only source of employment in the area—indeed, Mandsaur meets the entire country's demand for pencils and a wagonload of boxes leaves the district each day. Men who contract silicosis are forced to give up working and are then sometimes replaced by their wives or children, who in turn fall prey to the disease. As S. Chakrapani, general secretary of the Association for Voluntary Action (AVA) puts it, this is like a worker "signing his own death warrant out of desperation".

Following a spate of exposes in the local and national press, and questions asked in Parliament, the authorities have made some attempt to regulate the industry. In 1978, the Factories Act was applied to all units, irrespective of the number of people they employed. However, out of some 472 electric saws registered in 1982, dust collectors were installed in only 325 and even those don't work. The state government has asked Bharat Heavy Electricals Ltd to devise a dust suction device and this has been installed in one factory.

Meanwhile, an even more alarming case of silicosis has come to light. Tribals working in the quartz crushing industry in Godhra, Gujarat, are exposed to twice the Mandsaur dust levels. According to S.K. Chatterjee, former director of NIOH, quartz dust contains as much as 99 per cent free silica, as compared with 55 per cent in slate.

**Asbestosis**

Asbestos, is named after the Greek word for "unquenchable". It is a silicate, once considered a "magic" mineral because of its versatility: it could be used for the insulation of buildings and ships and also in car brake linings. Because it is highly resistant to heat and moisture, it is used in home construction as well. But it is precisely its toughness that makes this fibre one of the deadliest. It has to be processed before it can be used in some 3,000 different industrial applications. The tiniest fibres—unseen by the naked eye—are the most dangerous because they pass through the nostril's "screening system", line the air tubes and accumulate in the lungs.

The silica dust deposited in the lungs causes pulmonary fibrosis, leading to respiratory insufficiency and death; in more severe cases, it causes cancer of the air tubes and the gastrointestinal tract. In Britain, people living within one km of an asbestos factory were reported to be suffering from cancer. What is truly sinister is that cancer may strike five to 10 years after exposure.

A pamphlet, 'Asbestos: the dust that kills', published by the Centre for Education and Documentation in Bombay in 1983, states that the widespread and as yet under reported incidence of asbestosis is best summed up by Dr S.R. Kamat of KEM hospital in Bombay who notes: "There is no doubt that one-third of the workers in asbestos factories are suffering from asbestosis".

Factory managements do their best to hush up asbestosis cases. For instance, of the 240 workers at the Champion Asbestos Packing and Manufacturing Co, in Maharashtra, 40 suffer from asbestosis—and 16 have allegedly died of it—with their lung function disability varying from 10 per cent to 75 per cent. Although such cases had allegedly been detected by factory medical inspectors in the past, the reports had been shelved. Workers revealed that 20 of the victims opted for voluntary retirement, while six have been sacked. No action has ever been taken against the company.

This is by no means an isolated case. The Central Labour Institute (CLI) in Bombay has found that 58 out of 850 workers in an asbestos cement unit in Faridabad were suffering from the same disease. A similar study by the NIOH of 800 workers of Asbestos Cement in Bombay revealed that 224 workers suffered from an advanced stage of this disease. While the management flatly denied these figures, the study found that another 128 workers had contracted the disease.

Asbestosis has peculiar symptoms: a crackling sound while breathing and "finger clubbing", a thickening around the base of the nails. Asbestosis has a deadly twin brother: because the membranes of the lungs and abdomen are lined with the fibre, a victim can contract mesothelioma, an incurable and fatal cancer. Blue asbestos is 10 times more hazardous than white in this respect and some experts claim that after an exposure of just five minutes, a person can contract mesothelioma even 20 years later. Families of workers are also vulnerable because fibres stick to their clothes and they carry the menace home. US government health officials estimated in 1978 that in the US alone, 50,000 new cancer cases would occur annually for 30 more years as a result of past exposure to asbestos.

The asbestos industry in India is heavily dependent on imports; only 20,000 tonnes of asbestos is mined domestically and four times as much is imported. Asbestos is mined in Bihar, Andhra Pradesh (Cudappah), Karnataka and Rajasthan and imports come from USSR, Canada and South Africa.

The industry is dominated by big units, which have links with leading multinationals. Altogether there are 20 factories, employing 7,000 people directly. Conditions at India's largest mine, the Birla-owned Hyderabad Asbestos Cement Products in Roro, Bihar, are truly primitive. Some 1,500 tribals are employed in the mines, where they have to crouch for hours in dingy underground tunnels. If such exposure hasn't proved lethal, the fine dust particles are dumped in the open, exposing 50 tribal villages in the neighbourhood to contamination. Needless to say, the tribals of this area, known as Kolhan — which according to a government statement is supposed to be fighting for "independence" from Bihar—aren't provided uniforms, as employers are compelled to do in other countries. A joint study by the International Labour Organisation (ILO) and assistant director general of mines in 1978 on these workers' conditions has itself been gathering dust.

Two big manufacturers have come in for harsh criticism: Shree Digvijay Cement Co in Ahmedabad and Hindustan Ferodo in Bombay. Hindustan Ferodo is the largest producer of car clutch and brake linings in India and its British parent, Turner and Newall, holds the majority of shares. According to US researcher Barry Castleman, workers in the fluffing and carding sections—the dustiest areas are alone issued respirators. Here, an informant told him, the dust is like the cloud "behind a bus on a dirt road in the dry season" and the workers, not told of the dangers of asbestosis, often discard their respirators.

Prabhakar Sanzgiri, president of the Ferodo union, stresses the need for precautions right from the time the asbestos fibre is unpacked. Till 1975, jute bags were still being used and many would be split. "Now we insist that the original polythene bags be placed in another bag," he says. To make matters worse the floors of the factory are "dry swept" and casual labourers who carry away the waste dust are completely covered in it.

Asbestosis was only notified as an occupational hazard by an amendment to the Factories Act in 1976. However, as N.L. Gadkari, former chief inspector of factories in Maharashtra, underlines: "the moment a disease becomes notifiable, it just disappears. Take, for example, the case of byssinosis. This disease was made notifiable at the same time as asbestosis but it has practically never been heard of despite the profusion of cotton textile mills in and around Bombay."

Several precautionary measures need to be taken by both the government and the 20 asbestos companies. The

**Major asbestos companies in India**

| Name of the company | Product | Transnational corporation link |
|---|---|---|
| Hindustan Ferodo | Brakelinings, sheets, Yarns, jointings, textile, mattresses, millboards, packing cloth. | Turner & Newall, UK (T&F) |
| Hyderabad Asbestos | Sheets, millboards, pressure pipes, jointings, thermal insulation. | Johns Manville, USA (T) and Societe Italiana |
| Hyderabad Asbestos | Sheets | Turner & Newall, UK (T&F) |
| Shree Digvijay Cement Co. | Sheets and pressure pipes | Johns Manville, USA (T&F) |
| Sundaram Abex. | Friction Materials like brake linings. | Abex Inc, USA, (T&F) |
| Suri Asbestos Industry | Textiles, ropes, packings, yarn, laggings, jointings. | Johns Manville, USA (T&F) |
| Rane Brake Linings | Brake linings and clutch fecings. | Small and Parkers, USA (T&F) |
| Reinz Talbros | Asbestos jointings | Reinz Dichtung — A.G. West Germany (T&F) |

*T: Technical
*F: Financial

(Source: Director General of Trade and Development Handbook of Foreign Collaborations 1980).

### Predatory Plant

Few plants are as blatant about their disregard of pollution hazards as the Shree Digvijay Cement factory in Ahmedabad, owned by the Somanis. Barry Castleman, an American environmental consultant who has done pioneering studies on the flight abroad of the US asbestos industry because of fierce criticism at home, visited the plant and published his findings in the British journal 'New Scientist' in February 1981: "The road to the Shree Digvijay plant was lined on both sides by asbestos-cement waste. A high wall surrounded the factory. Outside, untreated wastewater emptied into a trench piled with solid asbestos waste on either side. Solid waste littered the neighbourhood where houses stand . . . . . Children played on the wastes around their homes."

The US journal 'Newsday' followed up with another expose, pointing out that asbestos was the worst killer of all industrial materials in history and has been dubbed "the bystander's disease". Respirators were provided only to permanent workers, while casual hands were given just a facecloth each month, which they wore across their mouths "like bandits". A 38-year-old temporary worker, Ramesh Khanna, told 'Newsday' how, with his barehands, he pulled out asbestos fibres from bags and dumped them into the mixing machines, where silicone and cement would be added. He would stir the dry mixture with a stick. "If I refuse to work today", said another worker, "I won't get work tomorrow."

The plant manager initially refused to allow 'Newsday' inside the factory saying, "We do not like this sort of inquiry. It creates problems. Asbestos is under serious attack in the US." He noted that their "foreign partner (Manville Corporation) became very upset" after Castleman's article appeared. "We are very conscious of the pollution," the manager added, mentioning that the firm was installing $1.7 million worth of water pollution equipment since the dust-bearing effluent was being released into surrounding paddy fields.

Ironically, the National Institute of Occupational Health (NIOH) is itself based in Ahmedabad. Dr S.K. Kashyap, the deputy director, told 'Newsday' that he had visited the plant several times. He described the cutting room, where pipes and sheets are cut with saws. "You become white with asbestos; the air is full of it like a cloud. Your hair and beard are full of fibres, like make-up for the theatre." The Central Labour Institute (CLI) studied what was believed to be this plant in 1981—it typically doesn't disclose the identity—and found that nearly 7 per cent of the 320 workers were suffering from asbestosis.

Transnational companies turn a blind eye to health hazards in the Third World—Sweden, in contrast, in 1975 banned virtually all use of asbestos except as fireproofing material following seven lung cancer deaths in an asbestos plant. But in India, the multinational corporations are not the only culprits: responsibility must also be placed, on the callous owners of such plants in India itself.

least that can be done is to warn workers that they are being daily exposed to a deadly killer and inform them what steps they can take to protect themselves and their families. Not the way the Hyderabad Asbestos mine at Roro does, with prominent signs in English exhorting workers to use respirators; when almost all the workers are illiterate tribals who can't even sign their own names.

### Byssinosis

Byssinosis is the scourge of textile workers. Textile and other fibre-based industries employ 1.05 million and cotton mills alone account for 0.8 million.

Cotton gives off a lot of dust as it is processed and taken to the blowing and carding rooms. Nearly all recruits to a mill soon complain of a transitory ailment, known as "mill fever", which disappears after a month. A second ailment, also shortlived, is "weaver's cough". The truly debilitating disease is byssinosis, which afflicts workers who have been employed for more than 10 years. Byssinosis is called "Monday sickness" because the symptoms manifest themselves immediately after a break. Workers start wheezing and coughing soon after they start work but these gradually disappear as the day wears on, the body adjusts to the situation.

However, the disease is progressive and in time, it causes permanent breathlessness and shortens a victim's life span. To make matters worse, it is caused by fibres so small which X-rays don't reveal. Says N.K. Mehrotra of the Industrial Toxicological Research Centre (ITRC), "In an advanced state, a byssinotic person cannot be distinguished from a case of chronic bronchitis and emphysema."

The KEM and MGM hospitals and CLI in Bombay studied three cotton mills between 1970 and 1975. The overall incidence of byssinosis among workers who were exposed to dust was 12 per cent, the rate being higher in the carding section. They found that the length of service was a crucial factor. The coarser the cotton used, the more the dust produced. Although data is difficult to come by, byssinosis has been reported in cotton textile mills in Ahmedabad, Bombay, Delhi, Kanpur, Madras, Madurai and Nagpur, with the incidence varying from 6 per cent to 20 per cent. In three independent surveys conducted in Bombay, Delhi and Ahmedabad, the incidence of byssinosis was found to hover around 7 per cent and 8 per cent.

A variant of this fibre-related disease is bagassosis, which occurs when sugar mill workers inhale the dust from bagasse or cane waste. The fibre which remains after juice is extracted from sugar cane is called bagasse and this useful "waste" is used to make board, paper and other material. During the drying of the bagasse fibre, fungi grows over it and when these are shredded to make bales, workers are exposed to clouds of dangerous dust. Bagassosis was first reported in India in a cardboard manufacturing unit in Calcutta which was using bagasse as raw material. Although the disease is generally transitory, it has been known to kill. The V.P. Chest Institute in New Delhi, has identified two types of bagassosis. In much the same manner, workers engaged in hemp, sisal and flax units suffer allergic reactions as a result of being exposed to dust.

According to Mehrotra, byssinosis can be prevented by redesigning work places, and by medical treatment. Dust can be controlled by replacing old machines with new, installing exhaust systems and providing respirators to workers. Bagasse can be sprayed with propionic acid to rid it of the fungus.

### Pneumoconiosis

The most common disease associated with industry is pneumoconiosis, better known as the source of "black lungs". It is endemic in mines—it was first identified at the beginning of this century—and workers who are long exposed to coal dust are not only rendered incapable of hard work but can also succumb to it. Although the Workmen's Compensation Act (WCA) was passed in 1923, this disease was made compensable only in 1959-36 years later According to Dr J.L. Kaw of the ITRC, "Dust predisposes a person to tuberculosis. It hastens the course of the otherwise latent disease. The patient dies sooner or later due to heart failure or tuberculosis."

A random survey by the Central Mines Research Station, Dhanbad, revealed that 8 per cent of miners suffer from pneumoconiosis, but this is obviously an underestimate since even in the US the proportion is higher. According to Dr P.K. Dutta, former president of the Indian Medical Association about six out of every 10 miners are physically unfit to undertake "hazardous and back-breaking jobs" in part because of their exposure to dust.

Moreover, as this industry gets more mechanised, the disease is likely to become a bigger hazard. As Dr Kaw writes of dust-related diseases generally: "The size and amount of the dust produced in any operation depends upon the speed of the impact. This has particular relevance to the mining industry. Operations which involve hand driven tools do not produce such dust (less than 5 microns) that is most harmful." One direct cause of pneumoconiosis is that loaders have to assemble at a site immediately after it has been dynamited, which means that their lungs inevitably have deposits of smoke and dust.

In 1983, it was reported that the plight of 20,000 coal miners in the Jhagrakhand pits in Madhya Pradesh was particularly pitiable. The authorities had opened up new sections without bothering to ventilate them; most exhaust fans were out of order. A worker alleged that whenever mining inspectors paid visits, the managers ordered fences to be put around new sections to convey the impression that no work was in progress there.

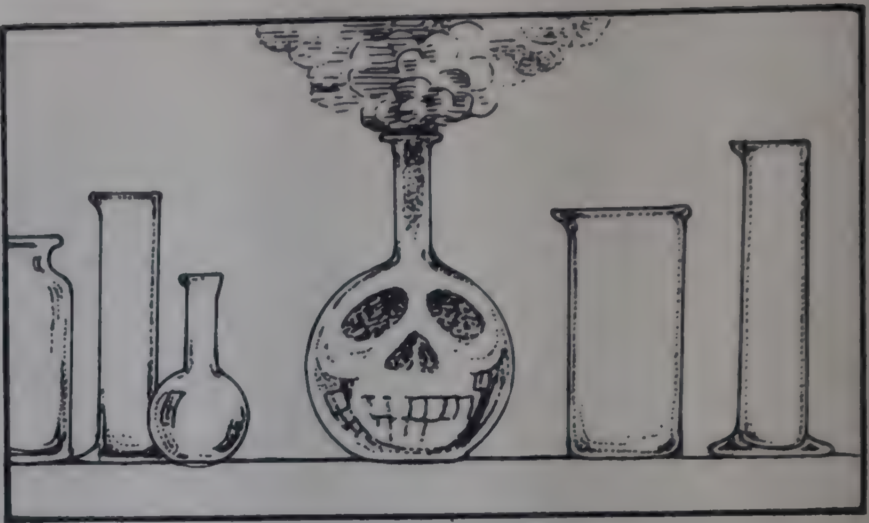
In spite of all the risks, medical facilities are minimal. In Jhagrakhand, the public sector's Western Coalfields hasn't provided a dispensary—or even an ambulance, for that matter—in five collieries in the area. The 50-bed TB ward in the hospital is headed by a junior physician. The drinking water is dirty and often full of coal dust, machine oil and fragments of rotting wood. In Dhanbad Central Hospital, nearly 500 to 600 miners die every year. Trade union activists have alleged large scale corruption and other irregularities in the running of the hospital.

Workers in mica mines too are exposed to serious lung diseases. There are extensive mica deposits in Bihar, Rajasthan and Andhra Pradesh, which supply three-quarters of the world's needs. The Indian Council of Medical Research has launched a pneumoconiosis survey of these miners in Giridih district.

According to a sample survey by Dr J.K. Sinha, deputy director of the Central Mining Research Station, Dhanbad, over one million workers are exposed to silicosis as well. Of a group of 150 workers studied, 10 per cent had an advanced form of the disease; a few collapsed later. "If a worker works six hours a day drilling stone, he dies in just five years," he points out. "If you take the man away from the job, he may survive but he will no longer be able to work."

## Chemicals

The growth of the Indian chemical industry during the period 1950-1980 has been phenomenal. Adverse health effects associated with exposure to chemicals in the work environment have been well documented in India, claims Dr C.R. Krishna Murti, former director of the Industrial Toxicology Research Centre (ITRC) in Lucknow. But he admits that only in a few cases has a strict cause/effect relationship been established. "Nor is it clear," he says, "how far the background health status of the workers, living as they do in unhygienic surroundings, exacerbates the toxic effects triggered by chemicals in the work environment."



Among the deadliest chemicals inhaled are fumes emitted in lead industries. Sulphuric acid, oxides of nitrogen, zinc and other chemicals are also highly injurious and can cause chest pains, bleeding, impotence, abortions and cancer. Even crane operators in docks have been reported to suffer from such diseases when handling toxic substances. In Bombay, one of the most widely reported cases in recent years has been the death by "gassing" of a worker in Rashtriya Chemical Fertilisers, a public sector plant.

Chemical units which manufacture insecticides are particular cause for concern. A four person enquiry team which examined working conditions at the Hindustan Insecticides factory in Delhi some years ago pointed out: "Almost every worker examined had a gassing incident which necessitated treatment and in a majority, inhalation of pure oxygen." It felt that improper opening of valves, frequent leaks and lack of precautions led to the leak of toxic chemicals. The NIOH, which also surveyed the same industry in 1978-79, confirmed that "toxicity symptoms such as headache, vomiting, nausea, stomach ache, skin and eye irritation and respiratory complaints manifested themselves either singly or in combination in a majority (73 per cent) of exposed subjects."

Extremely little is known about the incidence of diseases caused by chemicals. For instance, a large number of workers in units which make lead water pipes, paints and a host of other products are exposed to lead. But even in the industrially advanced state of Maharashtra not a single case of lead poisoning of a worker was reported between 1971 and 1983, though it is a notifiable disease under the Factories Act. The CLI studied 360 workers in a lead-acid storage battery unit in Bombay and found that around 9 per cent suffered from lead poisoning while two-thirds were exposed to airborne lead in excess of the threshold limit value (TLV). Those affected complained of paraesthesia, lose of muscle power, colic and exhaustion.

Dr G.G. Davay, medical inspector of factories in Maharashtra, claims that "a number of (lead) absorption cases would be found in industry. But these are not causes of poisoning. Lead factories are inspected once a year by the medical inspector of factories and every quarter the workers are examined." The workers have a different version. They state that the doctor only gives them a "shake-hand" test—they are asked to exert pressure on the doctor's hand while shaking,obviously a primitive method.

Obvious precautions are dust masks, but those doled out in a Bombay lead recovery factory are so shoddy that workers refuse to wear them. They get clogged all too easily and in the heat, the rubber lining causes dermatitis. This is why Dr Davay advises such workers to wear moistened fine cloth masks instead. The workers cover their heads with the cloth but seldom their mouth. "We can't breathe properly through them," they complain.

The CLI study showed that lead levels were appreciably lower in plants where proper technical control measures had been introduced to eliminate or reduce lead fumes and dust. Lead industries can modify and mechanise certain processes and generally improve their housekeeping to keep this menace at bay.

**Birla gas**

The Gwalior Rayon Silk Mills (GRASIM) factory in Nagda, 70 km west of Ujjain in Madhya Pradesh, has become a test case in occupational health. In June 1983, Padmanabhan V.T. a freelance journalist, published a pamphlet titled 'The Gas Chamber on the Chambal'. Padmanabhan, who spent six months researching factory conditions, made the startling allegation that 15 workers—out of a total force of 5,000—had died of "work-related" causes in 1982 alone. He gave a list of another 27 who were suffering at the time from such ailments; half were stricken with paralysis.

According to Padmanabhan's report, which was sponsored by the People Union for Civil Liberties (PUCL), the main problem was the release of carbon disulphide, which after prolonged exposure can cause permanent disabilities like paralysis and psychosis. The second culprit is hydrogen sulphide and the third sulphur dioxide.

Although the management claims that at every stage of viscose fibre production waste gases are recycled, there is no doubt that many gases escape and surround the factory workers for hours each day. As 'Sunday' reported: "There is no way in which the casual visitor can escape the 'Birla gas'. The spinning and after-treatment are the worst affected. What enters your system is unseen; it has a pungent, overpowering smell. It leaves you visibly weak, with a throbbing headache and almost-instant nausea."

GRASIM was quick to respond to that, according to another study, conducted by the industrial hygiene laboratory of the CLI in 1970 and released three years later, concentrations of carbon disulphide, hydrogen sulphide and sulphur dioxide were far below their respective TLVs. Their "negligible concentrations" in the factory, the management stated, "are not by any stretch of imagination hazardous to human health." The CLI carried out yet another study in August 1983, where it exonerated GRASIM of gassing its employees. It found that "no significant difference in health status was observed among the exposed and control groups except for those of psychic-neurological disorders which are more in the exposed group."

This fuelled the controversy, with Padmanabhan pouncing on the shortcomings of CLI's findings. The crux of the issue is that the imposition of a general TLV, of the kind that the Indian Standards Institution ISI lays down, isn't a sufficient precaution in poor countries, where the health and nutrition of workers is already so bad. A thorough medico-environmental study, therefore, is more reliable than a strictly "scientific" survey conducted on routine lines.

More specifically, Padmanabhan points out how the sample of 400 workers for the 1983 CLI study is biased in favour of the management. GRASIM chose the "stratified random sample" and didn't include temporary workers who may be badly affected as well. Dismissed or retired employees, with long records of service, ought to have been examined too. The on-the-spot survey done by 'Sunday', with Padmanabhan, gave actual cases of gas victims. Obviously, more in-depth studies than either CLI's or Padmanabhan's are called for.

### Staple of Death

Mangi Lal, a 38-year-old worker at the GRASIM factory in Nagda, points to his left hand and says, "This is not mine." His speech is slurred and a doctor at the local Jan Seva hospital has told him that it is a case of hemiplaegia (partial paralysis). 'Sunday' reports that he will take months, if ever, to report back to the staple fibre division, where he has been working as a "khalassi" for 16 years. He has already spent Rs 6,000 on medical treatment.

Another worker, Kaluram Jain, resigned from the same division in 1974 because he felt that he would perish if he continued to be exposed to the fumes there. Although he doesn't know which gas affected him, he knows the workplace is lethal. He suffers from cardiac disease and was hospitalised for six months at one time. Jain has filed a suit against GRASIM in the Ujjain labour court for physical impairment caused by the work environment in the staple fibre division.

Mohanlal Soni joined the division in 1960 and had his first stroke in 1973, when he was only 33. He spent three months, during his second attack in 1982, at the Jan Seva hospital and had to sell some land and his wife's jewellery to settle his hospital bills. Although he is back at work, he doesn't know how long he will be fit.

Padmanabhan also documents how some employees have died because of carelessness. In January 1983, a worker called Gokulram was overcome by gas while he was cleaning a furnace and was declared dead on arrival at the Jan Seva hospital. His body was rushed back to his village without a post-mortem examination. Employees cleaning the tank weren't provided respirators and it is very likely that the gas could be carbon disulphide.

Both the management and the medical authorities are callous. The doctor who heads the Jan Seva hospital says "I have done my own studies on the subject and, take it from me, these gases are not at all harmful. Do you know what the real problem is? These workers have been pampered. They lead cushy lives. The industry is such that they have no manual labour to do. They just operate machines and they've become lazy. All this talk about impotence—I too live in the same atmosphere, but give me two women at night and I'll put all those men to shame."

The management shrugs off the problem and asserts that it distributes free milk and vitamins to workers exposed to gases for long periods. It dismisses talk of a five-day week, as the 1959 study on the viscose rayon industry recommended, as "impractical". Workers in the staple fibre division aren't provided with respirators except in "emergency cases". No tests of the gas levels in the factory atmosphere are ever conducted; nor are workers given periodic health checks.

GRASIM, interestingly enough, has also come under heavy fire for dumping its effluent at its Mavoor plant near Calicut in Kerala into the Chaliyar river. This has robbed thousands of fisherfolk living downstream, an excellent shrimp breeding area, of their livelihood and its emissions have even damaged the plantations of the nearby villages. The Kerala Sastra Sahitya Parishad has fought a spirited battle against the management.

But the company has always had the last laugh. Any attempt to force the introduction of pollution control equipment meets with the stock response—if it is compelled to do this, it will simply close down. And it is the only big employer in a chronically backward region.

## Accidents

Most factories in India pay scant attention to worker safety. The facts speak for themselves: during 1965-75, according to official statistics, over 5,000 workers were killed and 25 lakh injured in industrial accidents. In 1980 alone, 806 were killed and 3.5 lakh injured; the previous year, 64 out of every 1,000 industrial workers in the country were injured at work. And the official data lists no more than 20 per cent of the total number of fatalities and accidents.

For one thing, it does not record accidents in units which employ less than 20 persons and use electricity, and in units which employ less than 10 and don't use power. It excludes one in every three factories which don't report estimates of injuries. Accidents involving casual and contract labour also go unreported: in one study of a large iron and steel company, these formed a quarter of the work force but suffered three and a half times more accidents than permanent employees.

### Fatal Accidents

Unguarded machines and work spaces are the primary causes of accidents in the industry. Severed fingers and limb and head injuries are common occurrences. Flying and falling objects, explosions, fires and structural collapses add to the toll. Factors which lower workers' concentration are night shifts, double shifts, high heat and noise conditions, poor lighting, vibrations and high work speeds.

Statistics on occupational injuries are available only for a fraction of the organised industry. They cover approximately 3.3 per cent of the total work force of 230 million (including agricultural workers). Fatal occupation-related injuries are bigger killers than even riots. In the organised industry, they kill 16 workers out of every one lakh every year.

This figure, applied to the total organised industry, means that a thousand workers die every year. Though the fatality rate in the unorganised sector is higher, the same figure applied for lack of better data, reveals that the industry kills 10,000 workers every year. However, the few studies, done on the agricultural sector indicate that the fatality rate in agriculture is much higher. On the basis of such studies, a researcher from IIT Delhi has estimated that the total number of persons killed every year due to occupational accidents could be anywhere in the region of one lakh.

**This flyover — a rush job for the ASIAD — collapsed and killed several construction workers in Delhi. (TOI)**

Official data is so out of touch with reality that in 1975, for instance, there was not a single injury in forest logging and agricultural operations. In the construction industry, only 39 were affected. N.L. Gadkari, former chief inspector of factories in Maharashtra, says: "Far more accidents go unreported than are reported. It is my experience that an inspector who may decide to act against employers has to reckon with a good amount of political pressure."

But even with incomplete data, the accident rate has been rising steadily. Between 1951 and 1978, the average daily employment in factories has increased by 120 per cent, while the number of fatal accidents went up 225 per cent and other injuries by 393 per cent. The textile industry, the largest single industrial employer—a quarter of the total—registers the most accidents—127 per every 1,000 textile employees in 1979, as against 58 in metal industries. Where cloth is made from raw cotton, machines crush, tear, pulp, comb and separate with a drum studded with spikes. These can easily lacerate a worker's limbs. The rollers can crush the fingers or dislocate the wrist, elbows or arms.

Studies of accidents in engineering units conducted by the CLI and other institutes reveal the shocking rate of 277 per 1,000 workers. Furthermore, six out of every 10 accidents were caused by unsafe working conditions. Out of 505 specific cases analysed, 257 related to unsafe positioning of workers next to machines, 132 to the failure to use safe attire and 98 to unsafe equipment.

Sometimes tragedies are caused by human error and greed. Freelance journalist Bharat Dogra cites three such cases in 1981. In June, 11 workers were killed—40 unofficially—during excavation work at the Bokaro steel plant. Only a few days previously, the inspector of factories had written to a Bokaro official pointing out the hazards at the site. The following month, a silk mill collapsed in Surat, killing 48 persons. Three stories were unauthorisedly added to the building and a 15-tonne machine installed on the top floor. Then, in Sivakasi, 32 people died when a fireworks "factory" blew up. This had electric fittings, whereas the law doesn't permit such installations in any workplace where crackers or other inflammable products are being made. The owner had fitted the lights to enable work at night to meet the Diwali demand.

The Sivakasi incident highlights the dangers to workers in small units. In 1982, for example, fire broke out in a small plastic toy unit in west Delhi and killed nine people. Plastic dyes and paints were scattered all over the courtyard and a lit stove provided the spark. Gross negligence was also responsible for the death of three workers and injuries to many more when a 85 ft chimney in a tile factory collapsed in Balaghat, Madhya Pradesh. Although the workers had drawn the attention of the supervisor to cracks in the chimney, he refused to close down the works for repairs. Immediately after the accident, police seized the attendance registers and "sealed" the unit. Several workers remained buried under the debris and their families were threatened with dire consequences if anything was made public.

Although the ISI has laid down safety standards for machines this is only true of selective machines and in any case, the standards are hardly high. What is more, there are barely about 60 small and medium units which make safety equipment in the country today. Their quality is poor and no one does any research on the improvement of safety equipment and materials.

### Mines and quarries

Injuries in mines are fewer than in other industries, but this is due to the official classification of "fatal", "serious" and "minor". A serious injury is one which involves permanent loss or injury to sight, hearing or fracture of any limb, or the enforced absence of an injured person from work for more than 20 days.

In 1979, there were, 2,853 serious injuries in mines, of which as many as 2,122 were reported from collieries. It is difficult to believe that safety conditions in other mines were adequate. In iron ore mines, for example, there were only 82 injuries that year, 126 in limestone quarries and only nine in stone quarries. Obviously, accidents in small, privately-owned mines—especially illegal collieries—go unreported. Minor injuries are probably not reported at all.

According to data from the Ministry of Labour and Rehabilitation, during the year 1983, there were 120 fatal accidents in Coal India when 161 persons were killed. This rising trend continued even in the first quarter of 1984 during which 30 persons died. In 1983, the maximum number of accidents occurred in Western Coalfields Ltd mines where 57 persons were killed in 50 accidents.

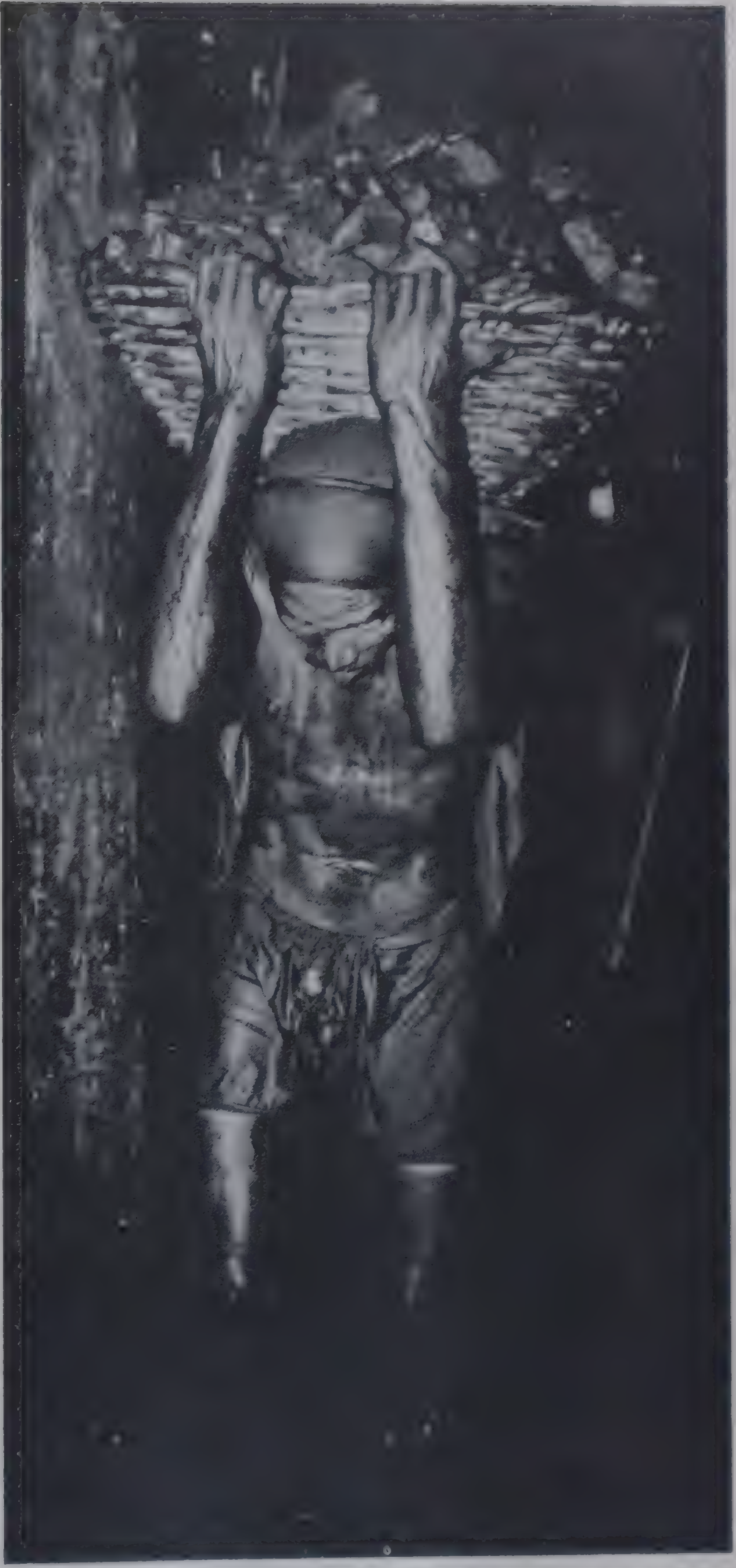
Official data seldom reveals the cause of accidents, only the number of people killed or injured. An explosion in the Chinakuri colliery in the Raniganj coalfields in 1958 was caused by the illegal detonation of explosives in mines despite the presence of methane. The number of casualties was thought to be 200. In 1976, 43 coal miners lost their lives in another explosion in Sudamdiho, which could have been averted if the mines had been properly ventilated after a four-day closure. Again, the disaster was caused by methane—known as "khunigas" (killer gas)—trapped inside.

The name that crops up most frequently when mine disasters are discussed is Chasnala. In these mines—where a World Bank loan was obtained for opening new mines while the old ones had been neglected—expert advice regarding the removal of water from old workings was ignored. As a result, part of the mine collapsed in December 1975, burying at least 430—officially 375—miners under tonnes of water. This would easily rank among the worst mining tragedies anywhere in the world in recent times and yet no one seems to have been punished.

Among the causes of mine accidents are the failure to comply with the provisions of the Indian Explosives and Mines Act, power breakdowns, faulty ventilation and insufficient precautions. When the roof of a Central Coalfields mine at Topa in Bihar collapsed in 1982 and killed 17, it was reported that some miners had refused to go down because they feared danger and nine recruits were asked to go with the others. The Coal India chairperson allegedly tried to blame the workers for the disaster and was mobbed by angry miners, who shouted "You are telling lies".

Cover-ups seem to be the rule. In the Rajya Sabha, some years ago, an MP cited several instances of officials responsible for mishaps being promoted. In a particularly glaring case, a Director General of Mine Safety (DGMS) official who presented a totally one-sided report of the Chinakuri explosion was rewarded by his being made the director general of that very organisation.

According to the Coal Miners' Officers Association, there are 99 unsafe coal mines in the country where operations, without proper measures, can only spell disaster. In Chasnala, for instance, the survey of the mine hadn't been conducted properly. The presence of the "mini-mafia"—goondas and gun-toting thugs—in Dhanbad and other areas hardly improves the situation.



**Work conditions in Indian mines are among the worst in the world. 430 miners died in the Chasnala disaster. (Smitu Kothari)**

Other dangerous mines are the Kolar gold fields in Karnataka. Because operations take place at enormous depths, rock bursts are always a threat. In the Dalli Rajhara iron ore mines, which supply the Bhilai steel plant, a senior DGMS official is known to have expressed his concern about unsafe conditions. Not only do roofs and walls collapse but the recklessness of truck drivers, who want to earn bonuses by transporting ore as quickly as possibly has led to a large number of accidents.

The plight of quarry workers, such as those in and around south Delhi, is well known but seldom finds official mention. According to Inder Mohan, general secretary of the PUCL, an accident occurs in Badarpur, Faridabad, Mehrauli, and other sites nearly every week but is systematically hushed up by the contractors. Figures disclosed in 1983 reveal that since 1977, nearly 45 workers—including women and children—have lost their lives in the sand and stone quarries of Bhatti, also in the same area. As many as 150 suffered grievious injuries, including loss of eyesight, in the same period.

An inquiry conducted by Lakshidhar Mishra, director general of labour welfare in the Union Labour Minstry has revealed that stone quarry owners in Faridabad were disregarding the 21 directions issued by the Supreme Court in 1983 regarding workers' safety and welfare. After visiting 18 quarries, he found that the 4,000 workers were still not getting drinking water and medical care. They continued to be paid less than the amount specified and blasting, which is particularly lethal, was being done by untrained workers. Mishra has supported the closure of four quarries, even though it has rendered many workers jobless, he says, employment cannot be given a premium over human life.

Conditions in the Paakur hills of Santhal Parganas in Bihar are not very different. This is one of the biggest stone quarries in the country, where the workers are mostly tribals and are practically bonded. Some, maimed by accidents, have been forced to begging. In the limestone quarries of Mussoorie, workers till a few years ago couldn't even claim compensation for injuries and contractors used to quietly dispose of their bodies.

Mine workers are afflicted by skin diseases—boils, carbuncles and dermatitis—as a result of toiling long hours in hot and humid conditions. As one miner puts it: "The water and sludge at the underground workface soaks right through the shoes and makes the feet soft and tender. Pebbles keep falling into the shoes as we clear away the coal. Since we're constantly moving around, the pebbles lacerate our feet. How often can we stop to take off our shoes?"

At the opencast iron ore mines in Durg district there is a significant incidence of sunstroke amongst miners who work in the sun during summer. The water provided to them is transported to open iron tanks at the workplace; the water heats up in the sun, and is a major reason for heatstroke and heat exhaustion.

Doctors also reported that due to the close-packed houses, communicable diseases like TB spread very rapidly, with viral infections assuming epidemic proportions in no time at all. The settlement itself is located between the mines and the railway stockyard and on an average day, trucks make nearly a thousand trips from the mines to the stockyard, passing through the settlement. Many pedestrians and children have become the victims of the speeding, loaded vehicles.

Reports from a number of coal-mining townships indicate that the water pumped out of the mines is supplied

## TB—an Occupational Health Hazard

Tuberculosis refuses to go away. Two out of every 100 Indians suffer from pulmonary TB and half a million die every year of the persistent malady. A moderately infectious case can infect a dozen others within a year. If such a case is not treated, the person will survive for about two years and during this time two dozen healthy individuals face infection. There are 2.5 million highly infective TB patients in India.

Malnutrition, poor hygiene, lack of water and persistent infections such as diarrhoea decrease a person's natural resistance. Inadequate housing leads to overcrowding and closer contact with infected persons.

Certain groups of people are more susceptible to the disease. The most vulnerable groups are those working in quarries, mines, textiles and other industries where the work itself exposes individuals to dust-related health hazards.

In Burhanpur, a small town in Madhya Pradesh, the incidence of TB is 150 per 1000 people, the highest in the country. This is a premier powerloom and bidi centre. There are powerlooms installed in most houses where workers are constantly inhaling fibre and dust. Coupled with poverty, squalor and conjestion, people rapidly develop pneumoconiosis, which eventually progresses to tuberculosis.

Silicosis also increases the individual's susceptibility to TB and makes the symptoms of TB more severe. The combination of the two, Silico-TB, is fatal and leads to death.

There are other industries where the working conditions are filled with occupational health hazards. A worker in the engineering unit of a plant manufacturing motors found he was constantly spitting out lumps of black particles. He was diagnosed as a TB case and the lumps found to be small particles of iron to which he had been overexposed. Even in a tailoring establishment where workers stitch heavily starched clothes all day, the risks of TB are unusually high.

With the advent of modern medicine, it is possible to cure a TB patient within 18 months with 90 per cent chances of success. But in India the efficacy of medical treatment is undercut by a variety of factors.

Surveys in India have shown that the BCG vaccine is not effective as a preventive measure in adults. However, it is considered still useful if given to infants; 15 million children are inoculated annually.

The major drawback of treatment with medicines (chemotherapy) is the long duration of treatment, for 18-24 months. It is difficult to motivate patients to take drugs regularly. When treatment is not continuous there is danger of the bacteria developing resistance to the drugs, causing additional problems. However today there are short-course drug regimens of 6-9 months that are highly effective, of low toxicity and well-tolerated.

But the discovery of a cure is not enough, if adequate clinics are not available for the afflicted. Only half of the known TB cases are provided treatment through 353 district TB centres. The bureaucracy in the functioning of these clinics, and the inability of the patients to afford the treatment, compounds the problem.

Another aspect of TB treatment, which exposes the skewed system of drug production in the country, is the acute shortage of life-saving drugs. In most primary health centres, there is a shortage of low-cost and "first line" drugs—particularly of streptomycin but also of INH and PAS. "Second-line" drugs are not available through the ordinary government set-up. But shortage of anti-TB drugs at the PHC has been known to occur from siphoning of drugs by the PHC staff. The biggest problem however is that drug multinationals are simply not interested in producing cheap, life-saving drugs. While useless vitamins and tonics, to pander to the fads of the middle class, are found in abundance in the country, TB drugs are sufficient only to meet the needs of about 10 per cent of the patients. The Federation of Medical Representatives of India has released figures to show that one of the multinational companies (Pfizer) manufacturing streptomycin produced in a recent year only one-fourth of its licensed capacity for streptomycin while producing four times its licensed capacity for iron tonic and vitamin preparations. The shortage of TB drugs is thus deliberate.

to the townships, after being decanted to settle dissolved solids. Coal miners from Chhindwara in Madhya Pradesh have reported a most peculiar phenomenon since the water supply was started: an elongation of the lower jaw-bone due to calcination. They have also reported outbreaks of gastric disorders among women and children due to the water.

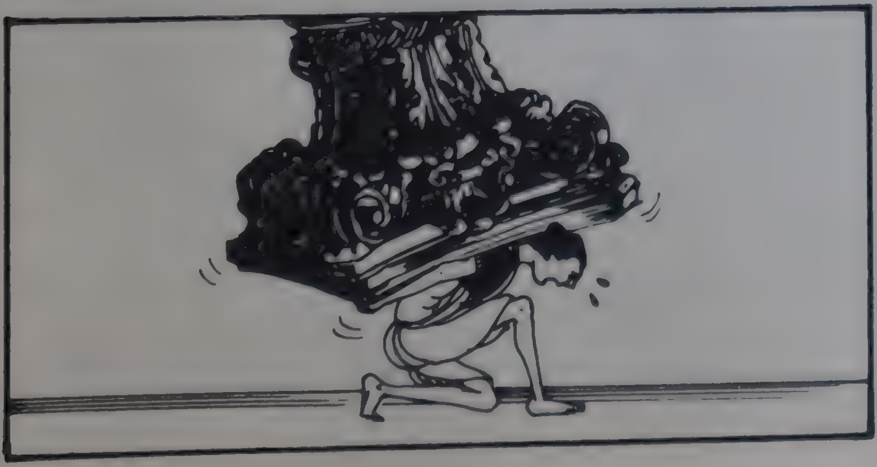
**Construction sites**

The trend in cities is to build taller and taller buildings and the graph of fatal accidents rises inexorably. The use by unscrupulous contractors of shoddy and sub-standard materials has also led to serious hazards: several colonies being erected by the Delhi Development Authority have faced collapse, injuring workers.

The haste to complete projects on time also has been responsible. A typical case was collapse of the flyover under construction near Sewa Nagar in Delhi in December 1981: 19 workers were, officially, hurt in the bid to hasten its completion before the Asian Games. Alleges Inder Mohan of the PUCL about the Asian Games building frenzy: "I have personally recorded 65 cases of death at three stadia and seven five-star hotel sites. The source of information was their fellow workers and nearby paan-bidi and tea vendors. Workers have been carrying loads to considerable heights up rickety scaffolding. Injuries caused while at work or deaths due to accidents are sought to be treated as top secret by the authorities. This is because of the total absence of safety measures as provided by law. Secondly by hushing up these accidents, payment of compensation can be avoided."

Because contractors seldom provide housing, infants—especially if both parents work—are injured by falling debris and rocks. At dams, too, workers are in constant danger. Nine, including three women, were buried when a huge mound of earth caved in at the Kanjahari medium irrigation project in Keonjhar district, Orissa, in January 1982.

At larger projects, the casualty list is much longer. In the Ramganga dam in Kalagadh district, Uttar Pradesh, a "probably incomplete" list compiled by a local newspaper cited 88 deaths and 501 injuries during construction. Since the work is on steep slopes which are landslide prone, risks are great. In the past corpses of migrant workers from distant villages would simply be flung without trace into the river. J.K. Patnaik, Orissa's Labour Minister, visited the Salal dam site in Kashmir where, it was reported, migrant labourers from Orissa who resisted oppression were being thrown into the Chenab. Workers fell at his feet, imploring him to rescue them.



## Noise and psychology

The textile mills are some of the noisiest workplaces in the country. The TLV is 85 decibels (dB), but mills invariably exceed this limit, as shown by an overview by the ITRC of health problems in the textile industry from 1925 to 1981. For instance, shuttle looms create such a din that workers usually communicate with each other by lip movements. The machinery in woollen and jute mills is even noisier than in cotton and silk. The noise level in a large weaving section ranges from 100 dB to 105 dB, and can cause permanent loss of hearing. In the US, no textile mill is allowed to exceed 100 dB for more than two hours a day—but Indian mills run three 8-hour shifts.

The situation elsewhere is similar. In the machine tool and automobile industries the maximum noise is caused by hammering. In fertiliser factories, compressors make the biggest racket. No wonder that many Indian workers find themselves shouting even at home, out of sheer habit. Says the ITRC: "The harmful effects of noise include increased annoyance, mental tension, irritability, and emotional disturbances at work and at home. Greater circulatory, heart and equilibrium problems were found in textile workers exposed to very noisy environments. The most pervasive and dangerous harm from noise hazard is the permanent, incurable deafness as a result of continued exposure to noise levels above 85 dB to 90 dB."

However, Dr G.G. Davay, medical inspector of factories in Maharashtra, rules out the noise hazard in textile mills. "I have not yet come across any textile millhand with loss of hearing due to overexposure to noise," he said a few years ago. "I do not mean that noise does not affect hearing. But in the absence of any direct proof, it is against the ethics of science to exaggerate the hazard. It will amount to creating a scare." But in the very same breath, he admitted that his department was not equipped to measure and study the problem "as the scientific world has been seized of it only recently."

In 1976, the government included "noise-induced hearing loss" as a notifiable disease. Any medical practitioner who detects such impairment has to report the case to the chief inspector of factories; failure to do so can be punished. An official committee has suggested that such disability should be brought under the scope of the WCA as well.

Noise can often be checked by using attenuators between different sections in a factory and protecting the relatively quiet areas from the menace. The CLI has experimented with some attenuators and found that these do not only reduce dB levels but are also more economical because they raise workers' productivity sharply. Dr Davay believes that "it is difficult to control noise in certain departments with the present technical knowledge". But even simple precautions like issuing employees in noisy sections with ear plugs or muffs are never taken.

Yet another occupational health hazard is psychological, which medical experts would term, "behavioural toxicology". Very often such symptoms are early warnings of impending physiological trouble ahead. Furthermore, different dusts and chemicals affect workers' behaviour in a wide variety of ways.

The earliest study was on manganese workers in 1958. Some of the common psychological symptoms were impotence, lack of concentration, irritability, insomnia, somnolence, unmotivated laughter, bad memory and depression. A quarter of the work force was found to suffer from psychosis and even insanity in exceptional cases.

The industrial psychology division of the CLI discovered in the early fifties that seven out of 10 workers in lead storage battery units were exposed to levels higher than permissible and complained of a number of mental symptoms. However, no effort was made to study the psychological and psychomotor (movement) changes which are attributed to the toxicity of lead till the CLI conducted a full-fledged survey in 1980.

It found that the 375 workers suffered from impairment of "visual intelligence"—their ability to react to pictures. Psychomotor capacity was also affected but the CLI cautiously concluded that while "lead uptake affects psychological functions and psychomotor capacities, it still warrants in depth studies to be substantially proved .... It nevertheless proves that some higher nervous functions are affected by a comparatively high exposure of lead."

Adds Dr Davay: "A number of absorption cases, or what we call sub-clinical cases, would be found in the industry. But these are not cases of poisoning." If it is difficult to prove cases of poisoning, those of psychological disability are even more so. Some early indications are localised muscular weakness—known as "wrist-drop". A lead recovery unit in Bombay has workers who complain that they occasionally lose control of two fingers of the right hand. But Dr Davay asserts: "That's not a wrist-drop but the worker perhaps has a spasm of some group of muscles." They also get exceptionally tired after a relatively short period at work.

The ITRC has now started a study of several industries where behavioural toxicology may be a hazard. Workers exposed to cyanide fumes and vapours in electroplating and heat treatment processes, for instance, may suffer from delayed memory and visual incapacity. Exposure to chemicals like xylene and toluene — in the coil insulation and mica section of large factories — are similarly affected. Petrol fumes in a refinery can affect both mind and body. The ITRC has found that workers exposed for more than five years can display abnormal behaviour. One worker was lethargic and confused; his movements were clumsy and he couldn't answer questions properly. Another appeared unusually quiet at work and was disinterested in routine affairs.

Two researchers have studied the chronic effects of exposure to pesticides on 44 sprayers. The average age was 37 and most were exposed for 11 years. They sprayed DDT and malathion round the year without masks or gloves. As many as 43 per cent complained of anxiety, sleeplessness and depression; 12 per cent reported that such symptoms worsened immediately after spraying.

Obviously, these psychological problems are uncharted territory so far as occupational health experts are concerned. Given the huge and varied nature of the work force in India, as well as the dichotomy between farm and industry-related diseases, the authorities will have to pay a great deal more attention to their diagnosis and treatment.

**Noise levels of 100 decibels are commonly reached in textile mills, which can permanently damage hearing. (TOI)**

## Transport workers

Very little work has been done on the special problems of transport workers. Loaders at docks are particularly vulnerable because they often have little idea of the toxic properties of the cargo. Several dockers have died cleaning holds where chemicals and crude oil were stored.

But the loads themselves are a hazard. The CLI's Industrial Physiology Division studied the manual lifting and carrying of loads by workers of the Food Corporation of India in 1978. Based on an examination of two groups—one carrying 93 kg bags of foodgrains and the other 50 kg bags of fertiliser—it tentatively recommended that the maximum permissible load be brought down to 50 kg.

To determine the "optimum load" for Indian dockers, the CLI conducted another study in 1980 at the request of the Labour Ministry. It found that back and stomach complaints were frequent among loaders, as was the high incidence of accidents. Significantly, other common ailments were missing because of their better health as a result of regular physical activity. Damage to the vertebral column and cardiovascular system was the biggest threat. The CLI suggested that the 50 kg limit be enforced.

Besides heavy weights, the dock workers—especially the contract labourers, of which there are 5,000 in Bombay port alone—lack protective equipment. Reports the 'Economic and Political Weekly', "In the sheds where he works lifting heavy cargo, he is very seldom provided with gloves, so that at the end of a day's work, his hands are severely mauled. He is not provided with shoes . . . . . In view of the fact that in every shed, hundreds of nails and metal pieces lie all over the place and the chances of being pierced by one of them and contracting tetanus is very high, this is a gross violation of the basic right of a worker to protective clothing. Hundreds of workers have been killed or disabled due to cargo falling on them from a height." A few years ago, workers refused to handle a cargo of naphthalene in a Russian ship docked in Bombay unless they were provided protective clothing. The port authorities hired cheaper contract workers, who unloaded the inflammable chemical without masks, shoes or gloves.

Sulphur is another dangerous chemical to handle. It often catches fire and burns silently in the holds of the ships, without any danger of spreading. Contract workers are compelled, in the course of their work, to walk over burning sulphur without shoes. On the fertiliser ships, the holds are filled with minute particles like a thick fog. Protective covering for the mouth and nostrils, if any, consists of a thin strip of cloth which does nothing to prevent the particles from entering the workers' lungs.

For railway workers, the biggest category of transport workers, the slightest mishap can mean death. The high accident rate on the Indian railways—there were around 350 fatal cases a year between 1962 and 1976—is often attributed to "human error" but it is never explained how much the heavy work schedules, the wear and tear due to overuse are responsible. A couple of years ago, the Railways Reforms Committee took the services to task for adopting an almost cavalier attitude to the safety of operations.

Finally, bus and truck drivers and their assistants. Any study of the careless handling of buses and trucks by drivers would also have to take in the poor maintenance of vehicles, either by undertakings like the state transport corporations or private operators. The bonuses that truckers earn on speedy delivery are among the factors which make the overall accident rate on Indian roads about the highest in the world.

**Over 10,000 people in Punjab have had hands chopped off by badly designed threshers . (TOI)**

## Farm workers

A visit to any public hospital in the capital around Baisakhi in April would reveal several cases of labourers who have injured themselves at the start of the wheat threshing season. In the Safdarjang hospital, for example, between six and eight cases come in daily during this period. One such victim in 1984 was a 12-year-old boy, Zakir Hussain, who is considered one of the "luckier ones" because his hand did not have to be amputated. Between 1979 and 1981, this hospital admitted 200 cases—and in as many as 117 the victim returned home minus a limb.

While labourers in the vicinity of large public hospitals with surgical facilities have a good chance of being saved, like Zakir Hussain, the plight of farm hands in remote rural areas is terrible. These accidents occur as a rule at night because threshers only receive power then, as in Ballabgarh and Bulandshahr. By this time, workers are already exhausted after a day's work and their reflexes are naturally not what they ought to be.

The official estimate is that about 1,000 farmers are injured throughout the country during the three-month wheat harvesting season. Hands and arms are either badly mangled or have to be amputated, which means that the victims often can never work again. According to a survey by Dr S.R. Verma and B.S. Bhatia, farm power and machinery experts at the Punjab Agricultural University, more than 10,000 people working on threshers alone have had their hands chopped off.

That is a classic "ergonomic" problem: the machines are simply not fitted to the weary workers who operate them. A number of studies reveal the use of sub-standard material by thresher manufacturers. They have not incorporated even the most elementary safety features in their design, not even to ISI standards. Most machines do not have the prescribed 90 cm feeding system—basically, more than an arm's length—and the length of the cylinder cover is less than 45 cm. But the tragedy is that—just as the factory workers discard respirators because they find it difficult to breathe with them—many farmers remove the chute

**Not one farm worker was found wearing masks while spraying pesticides during a recent survey in Gujarat. (TOI)**

because it slows down the process.

A recent study by the Department of Agriculture, Haryana, shows that more than four out of every 10 accidents occurred in a thresher not manufactured to specifications. Human negligence was also responsible: 95 per cent of the accidents took place while the crop was being fed into the chute. The overall rate was 25 accidents per 1,000 machines.

Much of the work in the Green Revolution areas of the northwest is done by unskilled workers from Uttar Pradesh, Bihar and Rajasthan, whose poverty compels them to work almost round the clock in certain seasons. The farmers too are anxious to finish threshing before the onset of the monsoon, and since they usually rent the machine from a neighbour by the hour, time is of the essence. The workers often try to beat their drowsiness at night by using intoxicants, which only compounds the problem.

A report titled 'A Bloody Harvest' by Devinder Sharma in the 'Indian Express' points out: "Farm mechanisation is picking up in the country. Every year, about 50,000 threshers are added to an estimated 8 million already working, mostly in the Punjab, Haryana, Uttar Pradesh and Delhi. Although legislation (which advocates the banning of all sub-standard machines which do not follow the design and specifications laid down by ISI) has been proposed to curb thresher accidents, it seems to be all eyewash. So far, the Union Agriculture Ministry has only asked the states to implement the Workmen's Compensation Act (WCA) of 1923 and the Essential Commodities Act."

The WCA requires a farmer who owns a thresher to deposit Rs 45 as insurance premium on behalf of every two labourers. The General Insurance Co (GIC) is meant to pay Rs 16,000 to each labourer who loses either a hand or a thumb and four fingers. "The problem is," Sharma adds, "that the farmers don't want to pay the premium amount for they know they can easily get away by settling the amount of compensation money with the poor labourer who has no idea of what his rights are. The government's laxity and non-cooperation on the part of the farmers have stalled all efforts to enforce the act."

Even at places where the act has been enforced, huge amounts of compensation money are held up in the banks due to legal complications. The act provides for payment of the insured amount to the legal heir of the victim in the state where the mishap occurs. Since the farm labourers are mostly migratory, it becomes difficult for them to bring the legal heir from their native place to claim the money.

The state governments of Punjab, Haryana, Himachal Pradesh, and Jammu and Kashmir have rejected a proposal to insure migrant labourers against thresher mishaps. The New India Assurance Co, a subsidiary of the GIC, had suggested an insurance scheme under which each farmhand would be insured for Rs 5,000 for just Rs 3.21 a year paid by the state government. These northern states have expressed their inability to adopt the plan for lack of funds, which is ironical, considering how they boast about their high agricultural productivity—without ever mentioning that it is these migrants who do the hard work.

Compensation in accident cases is either too little or too late. In a government-run cattle breeding farm in Dumrao, Bihar, it was reported that two workers who had their hands chopped off by a cutting machine a few years ago have yet to receive compensation, as have the dependents of a third who was attacked and killed by a buffalo, and another worker who died when he fell from a tree. The first two had their wages deducted when they were hospitalised.

Labourers engaged in felling trees in Tehri Garhwal are in perpetual danger of losing their lives: they have to climb 25-metre-high conifers which do not offer much support or are crushed when logs tumble down. When they perish in an accident, the contractors bury them surreptitiously; if at all any compensation is provided, it is the grand sum of Rs 20 to cover the cost of a coffin. In an exceptional case, Tehri-based lawyer Vidya Sagar Nautiyal won adequate compensation for labourers and their dependents.

### Greed revolution

Another factor in farm hazard is the profligate use of fertiliser and pesticides. The latter, in particular, are the most hazardous because they are sprayed on crops by farmers who simply are not aware of the damage they are doing to themselves. To add insult to injury, some of the pesticides freely used here are banned in the West. Typical examples are DDT, BHC and methyl parathion, of which 7,5000 tonnes, 33,000 tonnes, and 3,000 tonnes respectively are used each year.

A survey by the Indian Institute of Management, Ahmedabad, of workers spraying pesticides and engaged in dusting operations in five Gujarat districts revealed: "None of the labourers were provided with masks to prevent the inhalation of toxic chemicals. Goggles to protect the eyes were also not available. Only 50 per cent of the workers took the precaution of covering their nose and mouth with a cloth. Besides, 20 per cent did not wash their hands after completing the operations, and of those who did, the percentage of workers not using soap was 64 per cent, though washing with water alone is utterly inadequate." Organophosphates are the most toxic of these chemicals.

Praful Bidwai reported in 'The Times of India' in 1983 that all the 14 executives that he spoke to in the course of an investigation into safety hazards in the pesticides industry admitted that "even the most toxic chemicals, including those that have high dermal toxicities, are mixed by hand". When the National Commission on Agriculture asked state governments to furnish information on use of imported pesticides, it got a very poor reponse. The situation is no better as regards domestically produced chemicals. In 1981, the Andhra Pradesh government announced the sale of non-permissible time barred pesticides valued at Rs 35 lakh, stockpiled in government godowns. This could prove disastrous because some pesticides turn into highly toxic substances following decomposition.

Greed is by no means confined to the "revolutionary" states of the northwest. Some months ago, a commission inquiring into large-scale aerial spraying of crops in Tamil Nadu discovered that politicians in the highest places were getting a cut in the contracts awarded to private plane operators and hence they were abetting the gross overuse of pesticide—with no thought to the hazards to farmers or, indeed, to the people who consumed the crops eventually. Cotton farmers of Haryana have also protested against aerial spraying of pesticides because they believed that this damaged other crops and fodder more than it helped the cotton.

According to Bharat Dogra, "Recent news reports from cotton growing areas, speak of 'thousands of cases' of pesticide poisoning and dozens of cases of cancer, stunted growth of farm workers' children, deformities, blindness, diseases of the liver and the nervous system." Because of the extensive use of toxic pesticides and the lack of elementary precautions, it is likely that India is somewhere at the top of the countries reporting such cases of poisoning.

Other dangers that farm labourers are exposed to are brucellosis, which is conveyed by germs and worms in contact with cattle; anthrax, which wool sorters contract and can affect the lungs; "farmers' lung", which is a disease borne by germs and causes an asthmatic condition. Since women and children work together with men in the fields, they are much more vulnerable to these hazards than those who do ancillary jobs in factories. It is certainly time that the authorities paid more attention to the health of this suffering majority.

## Health laws

In the Directive Principles of the Constitution, the government is enjoined to direct its policy "towards securing the health and strength of workers" and each state is required to "make provisions for securing just and humane conditions of work". Unfortunately, no single law deals with occupational health in its entirety. Three acts touch different aspects: the Factories Act, 1948; the Employees State Insurance Act (ESIA), 1948; and the Workmen's Compensation Act (WCA), 1923.

A review of these three reveals that a large number of workers who are exposed to hazards at their place of work are excluded from their purview. The Factories Act covers any manufacturing unit which uses power and employs more than 10 workers (miners are separately treated, as are restaurant and hotel employees). The ESIA, which covers units with more than 20 workers, does not distinguish between employers who use power and those which don't. The WCA covers, in addition to both these categories, miners, ship crew, construction workers, firefighters and plantation labourers. It is obvious that workers in small "sweatshops" all over the country, construction workers and those contracted by outside agents within large units are not protected either by the Factories Act or the ESIA.

A typical example are the agate workers of Khambat in Gujarat. One survey found that 64 per cent were suffering from disease as against 36 per cent in the control population. Even pre-teen children were found to be seriously affected. But because their workplace does not qualify as a "factory" under the act, agate workers cannot ever hope for legal aid or compensation.

The Factories Act lays down provisions for the general health of workers by prescribing detailed instructions regarding cleanliness, disposal of wastes, ventilation and temperature, dust and fumes, artificial humidification, overcrowding, lighting, drinking water, and latrines. Safety regulations are also dealt with. The act says that when a worker dies or is seriously injured, the factory manager has to notify the appropriate authority. It also empowers the government to appoint a competent person to enquire into the causes of an accident or occupational disease. The person making the enquiry has to submit the report to the government, which may publish it if it feels it is in the interest of the community at large.

According to the law the worker has to show a correlation between the ailment and the work environment. For instance a worker who has contracted a chest disease has to prove through circumstantial evidence that the disease is due to working conditions in a particular plant. However, such cases are usually very difficult to establish.

While the act lays down broad guidelines for protecting health, it does not specify standards and state governments have been permitted to exempt some cases from its purview. Hence the provisions read more like general recommendations. Regarding dust and fumes, for example, the act states that "effective measures shall be taken to prevent its inhalation and accumulation in any workroom, and if any exhaust appliance is necessary for this purpose, it shall be applied as near as possible to the point of origin of the dust, fume or other impurity . . . ." The specific "effective measures" and the number of exhaust fans are determined by the factory inspectorate in each state.

## Women at Work

Women at work are doubly oppressed: as workers and as women. In the slate pencil works of Mandsaur or in mines, women are exposed to dangerous particulates every working day, though to a lesser extent than men because they do not perform certain tasks—like operating the electric saw in the slate units. However, in many occupations they actually do more physically exacting jobs than men.

A classic example is the tobacco processing industry, one of the few occupations where women far outnumber men, others include plantations, cashew processing and garment making. While tobacco leaves are being cut and rolled, a great deal of dust is raised and this is directly inhaled by the women. It coats the mucuous membranes of the windpipe: they can neither spit nor swallow. It is also a minor eye irritant.

In a major processing centre like Nipani in Maharashtra, women work in the tobacco sheds every day, while the men stay at home and do some farm tasks. Thus the women have not only to put in a full day's work but also do housework, as well as help in the farm with winnowing and sifting, which are considered "domestic" occupations fit only for them. In effect women in the area have three separate tasks to perform.

In Nipani there are a hundred odd factories employing about 4,000 women. Besides the usual chest related diseases, it is suspected that the tobacco dust is affecting the menstrual cycle of the women and lactation in young mothers. The several representations made by the women have failed to improve working conditions.

What is worse, working women are in a bad state of health to begin with. They suffer from malnourishment, anaemia and general disability because their diet is most inadequate. Particularly on farms, women have to work because they belong to landless families and must offer their labour for a pittance, failing which they have to migrate with their families to the nearest town. The situation regarding pregnant or lactating women is no better.

The laws concerning occupational health like the Factories Act, Mines Act, Equal Remunerations Act and Maternity Benefit Act do not apply to women in the unorganised sector, who are nevertheless a high proportion of such workers. Yet the Maternity Benefit Act could be extended to all industries, as the Committee on Status of Women suggested in 1971. This could be ensured by the creation of a central fund with contributions by employers. The ESIA can also be widened to cover self-employed (particularly home-based) women who supply their products to industries. Positive gender discrimination is essential in these cases, given the special disabilities that such women face.

**Tobacco dust affects lungs, menstruation and lactation. (M.A. Rahim/India Today)**

Similarly, state governments are left to devise rules for any factories which expose workers to "serious risk of bodily injury, poisoning or disease". The Maharashtra government, in its Factories Rules of 1963—regarded one of the most stringent among various states—has classified 21 processes as "dangerous operations" and prescribed detailed regulations for each of them.

Another major lacuna in the act is that except in the case of accidents, an offending company cannot be sued directly by an affected employee or a private citizen. The remedy lies in filing a writ against the state and its enforcement bodies. This round about way only forestalls justice.

The ESIA established the Employees State Insurance Corporation (ESIC) to provide benefits in the event of sickness, maternity, and employment injury to workers whose monthly income is less than Rs 1,000. Provision is made for sick leave without loss of wages in cases of injury or 22 occupational diseases listed in the Factories Act. There are four special cases as well: coal miner's pneumoconiosis, telegraphist's cramp, bagassosis and compressed air illness, in factories where air is compressed under high pressure. But many factories employ casual labour and thus evade provisions regarding leave by discharging and reemploying them frequently. Some firms split their employment in such a way as to evade the act.

The WCA provides ordinary remedies for the damage suffered by injuries and occupational diseases. It lays down the elaborate procedure by which the worker—or dependents, in case of death—has to serve notice on the employer. Since no one is in the proper frame of mind to do so when a serious casualty occurs, failure to comply with these cumbersome provisions is all too common.

Small establishments avoid paying compensation by one means or another. There are huge and avoidable delays in disposing of applications for compensation. Workers either don't know about their rights or have only a vague idea. No one is generally available to render legal aid to them. Because of sheer poverty, a worker is often compelled to accept much less than what is legally due. Sometimes, contractors take a receipt for the full sum after paying less. According to the act, it is not compulsory to report non-fatal injuries to the commissioner, which means that there is no way of knowing whether claims have been made. Finally, the list of occupational diseases listed in the act is too small.

The gaping holes in all these laws can be underlined in the case of one of the commonest industrial diseases—occupational dermatitis. Workers in chemical and plating factories are very susceptible to it; so also are paint and press workers. It inflames the skin, which becomes swollen and itchy. However, workers suffering from this uncomfortable disease are not entitled to medical benefits or sickness leave. Nor are they entitled to compensation under the WCA. They must fend for themselves and must return to work as soon as possible, or face being sacked.

**Government action**

The enforcement laws relating to occupational health is woefully inadequate. The Factories Act requires that each state should have a chief inspector of factories, the primary enforcing authority. Chief inspectors, advised by the Directorate General of Factory Advice Service, may propose egal amendments to existing laws. Working under the chief nspectors are certifying surgeons and inspectors, including medical inspectors.

Certifying surgeons examine all factory workers and supervise the diagnosis and treatment of occupational diseases. They are also responsible for determining the health hazards in any new manufacturing process or of any new substances used on the shop floor. And yet, in Maharashtra, there are only two certifying surgeons and one of them is also one of three medical inspectors for the whole state. A decade ago, the Labour Ministers' Conference recommended that there should be an inspector for every 150 factories in a state, whereas today, the inspector has to cover at least twice as many. In Bihar, for instance, an nspector has to visit 1,100 factories a year, which is plainly an impossible feat.

Maharashtra, with 19,000 factories, has only a hundred nspectors. Many posts remain unfilled because of poor pay and little opportunity for promotion. As Dr Surendra Nath of he CLI has pointed out, medical inspectors are seldom made chief inspectors. Workers, doctors and social activists allege hat there is little commitment on the inspectors' part of mproving worker health and complain of collusion between nspectors and managements. In one asbestos company, employees say that a high ranking government official has been regularly passing off asbestosis as TB.

More specifically, there are no clear-cut provisions regarding the nature and quality of respirators, protective clothing and engineering controls, with the result that managements have no qualms about providing substandard devices. In some factories, face cloths are handed out nstead of breathing apparatus.

A serious lacuna in the Factories Act, especially in regard o diseases like silicosis and asbestosis, is the absence of any compulsion on the employer to show medical records to workers. In many cases, employees are totally unaware that hey are suffering from a crippling or even a fatal disease nd are under the impression that their complaint is of a general nature. Only the factory inspector has the power to nspect the records of companies. Had the workers any nkling of what lay in store for them, they could approach private doctors.

Finally, the government takes little notice of big employers who circumvent the Factories Act by doling out work to small-scale ancillaries which are not under the law's mbrella.

The enforcement of the ESIA and WCA is also far from atisfactory. Says a leading environmental activist from Madhya Pradesh: "The WCA, as framed, is excellent, but in practice there is very little justice done. In all of Shahdol, for example, compensation has only been received in about 40 cases in recent years. For one thing, mine owners not only keep employees' records badly but also manipulate them. Thus dates of birth and service periods are tampered with, o avoid paying big sums. Very often, sick or disabled workers are simply made to retire prematurely."

**Government's law enforcement is woefully inadequate. Overcrowded working conditions are common.. (P. Pushkarna/India Today)**

In the Sivakasi explosion in September 1981, when 32 people were killed, the lawyer for Arunachalam Fireworks succeeded in browbeating the dependents into accepting a lower compensation. The government sided with the factory by advising them against staking higher claims. According to 23-year-old Rukmani, wife of a victim, the deputy labour commissioner said that she should accept Rs 10,000, as against Rs 25,000 and if she didn't he warned her to "be prepared for a protracted legal battle. We know how to keep on adjourning".

In fact, when the government conducted its "enquiry", no questions were asked: there was no cross-examination or deposition. The monthly wages were estimated at Rs 60, compensation of Rs 10,000 computed on this basis and offered to the dependents. The real wages were twice as much. A reporter's investigations revealed that no worker was ever given a pay slip; nor were their signatures ever obtained on a voucher.

Apart from the laws passed soon after independence, as well as the inspection and enforcement apparatus, a number of research institutes have been set up. These include the Central Mining and Research Station in Dhanbad under the Council for Scientific and Industrial Research (CSIR), the Industrial Toxicological Research Centre (ITRC) also under the CSIR, and most important, the National Institute of Occupational Health (NIOH) in Ahmedabad,

FAO

## Child Labours

India has the dubious distinction of having the largest number of child labourers in the world—16.5 million at last count, according to the International Labour Organisation (ILO). Obviously the vast numbers of children who do unpaid work or help their mothers and fathers are not included. Indian children toil in the "most inhuman conditions" in the world, adds the ILO.

Child labour is more common in rural areas. The Rural Labour Enquiry Committee estimated that children work 280 days a year, earning roughly half the adult wage. In plantations, they work 40 hours a week, as compared to the 54 hours put in by adults. Says Smitu Kothari of the People Union for Civil Liberties (PUCL): "The worst exploitation of children as labourers takes place in the unorganised, informal and unregulated sectors. Nearly 40 per cent of India's total working force in 1961 was in this sector. In the organised sector, child labour has declined from 0.48 per cent in 1948 to 0.05 per cent in 1971."

In recent years, child labour has increased in the traditional handicraft industries as well as the new labour intensive industries where the investment per person employed is low. The former include carpet weaving, zari-making, brassware and precious stonepolishing. The child does pick up a skill and inherits a tradition; the exploitation is a little less severe because of the family ties inherent in such a system.

A report on the workers who make brass instruments for geometry and art work in Roorkee, Uttar Pradesh, mentions that 400 children are engaged in this industry, mainly in packing and moulding. In fact, children outnumber adults in the moulding units three to one. When the brass is heated, gas escapes and is inhaled by the young workers; when brass melts, it sometimes gives off sparks which burn their eyes. Again, when the molten liquid is poured into moulds, it can spill onto hands and legs. A few children also help to finish the instruments, which requires them to bend over the objects for 12 hours a day, for which they are paid Rs 5, as against Rs 12 earned by adults. Their parents are aware that they are depriving their sons and daughters of even a rudimentary education but, poor as they are, they have no option.

Similarly, in Kashmir's carpet weaving industry, some 6,500 children between eight and 10 years old are employed for over eight hours a day for a monthly Rs 80. They work in congested sheds in long rows behind giant looms. The air is thick with particles of fluff and wool and a study has indicated that 60 per cent suffer from asthma and TB. In the handloom, zari and embroidery industries, the physical growth of children is affected because they have to crouch for hours on end over the material they work on.

Yet another traditional industry is the processing of agate, a semi-precious stone, in Khambat, Gujarat. It employs some 30,000 workers, who include a sizeable number of children. A study of 342 workers, 35 of them children, revealed that more than six out of every 10 suffered from lung diseases. Half the children surveyed had lung diseases and five had pneumoconiosis. "The most shocking finding," report the researchers, "was that a child as young as 11 years was suffering from this disease."

The plight of beedi workers in Nalanda district of Bihar was vividly described by 'India Today' in 1983: "Six-year-old Shahid is dragged out of bed every morning by his ageing father, Mohammed Ishaque. A quick cup of tea with the leftover rotis of the previous evening, and then a mad rush to the beedi factory. With his sieve, scissors and mat, he works from eight to six, with a brief break for lunch. At the end of the day, he collects Rs 2 for his labour." Says Ishaque: "He started working when he was only four years old but the contractor still considers him a learner. If he does not work, he will not eat."

In Nalanda district alone, 45,000 workers make beedis in dingy "godowns". All the villagers of Karah are beedi rollers; the children are employed—against the law—on the pretext that they are "learners". TB and severe back ailments are widespread. The same situation prevails in other beedi centres scattered throughout the country like Sagar district in Madhya Pradesh. As agriculture gets mechanised, poor rural families are thrown out of work and take to making beedis, the dust of which also harms their health. There are now no fewer than 3.5 million workers in this industry. "Meanwhile," concludes 'India Today' grimly, "for six-year-old Shahid and thousands like him, life continues to burn out like the cheap beedis they produce—day after day."

The Ferozabad glass and bangle units in Uttar Pradesh employ many children too. This is extremely hazardous because their young limbs are easily lacerated; even their eyes can be permanently damaged by splinters. It is common to see young children with bandages on their arms hard at work. Not surprisingly, the glass workers of Ferozabad suffer from an exceptionally high incidence of TB and are also affected by fumes.

No adult survives more than 15 years in the slate pencil factories of Mandsaur, and children too are inexorably drawn into these dust-laden dens for a pittance, from the time they are 11 or 12, because by the time they are 15, their parents are in no position to continue working. Even nine-year-olds pack pencils. One indication of the state of affairs in Mandsaur district is that a middle-level school in Multanpura has been reduced to a primary school for lack of attendance.

The match factories at Sivakasi are particularly notorious. As many as 45,000 out of a total workforce of one lakh are children below 15. As a supervisor says: "We prefer child labour. Children work faster, work longer hours and are more dependable"—and don't form unions, or take time off for tea or cigarettes.

The children of Sivakasi work 14 hours a day. Those below 10 earn Rs 2 a day and the rest Rs 6. Smitu Kothari visited the shed of Velmurugan Matches, where seven were children below 14 and two were just five years old. In another village, the factory owner's bus picked up 130 children at 3 am and dropped them home "safely" at 7 pm—16 hours away from home. They were all eight to 12 years old and 80 per cent were girls.

Kothari describes conditions in a typical match unit in the area: "Down the long hall, lit patchily by sunlight coming in through open windows, sat row upon row of children, almost 250 of them all of them around 10 years of age, all immersed in their work." In front of each one of them lay a small mountain of headless matchsticks, and the children's hands flew from those piles to frames they balanced on their laps, inserting each matchstick painstakingly into its slot in the frame. There was obviously pressure to fill each frame fast, for the children never looked up. Even at 'lunchtime', as their right hands unconsciously pecked at the food they had brought from home, their left hands mechanically continued to insert matchsticks in the frames. On every face was an expression of utter blankness, masks on an army of child robots."

When Diwali approaches, the pace frenzies up and the children even work through the night. In February 1982, six children were burnt to death while they stuffed gunpowder into crackers. A case was registered under the Indian Penal Code and the Explosives Act. An investigation was launched. Typically, nothing came of this and the owner was back in business. In September 1981, there were six children among 32 workers who had died in another explosion in a factory on the outskirts of Sivakasi. The owner offered doles but made no attempt whatsoever to take precautions to avert similar tragedies recuring.

Sivakasi and Mandsaur are well known areas of child-abuse. There are lesser known horrors. The ILO refers to private mines in Meghalaya where children have to crawl through trenches 90 cm wide and one metre high. As soon as their size is no longer profitable, they are thrown out on to the streets. In the carpet industry of Varanasi and Allahabad districts, 200 children from Palamau in Bihar are reported to be working virtually as slaves. Early in 1984, 26 such children were freed from bondage and interviews with parents in Palamau reveal that another 214 are still missing.

The Constitution clearly states children should not be forced by economic necessity "to enter vocations unsuited to their age or strength". More specifically, it rules that "no child shall be employed to work in any factory or mine or engaged in any other hazardous employment." There are some 12 acts to enforce such regulations but these do not all prescribe a single minimum age. What is more, the age differs from industry to industry and also from state to state. Similarly, there is no legislative uniformity of working hours, rest periods and restrictions on working at night.

Given the deepening poverty of the countryside, it is presumptuous to imagine that children can be barred from certain industries. The government introduced a bill in 1982, amending the Mines Act to ban child labour: no person below 18 would be employed in mines. It was also proposed to increase the period of paid leave from one day in 16 days to one in 15. Any such move to ban children from work, however well intentioned, may either drive families into further penury or simply encourage evasion on an even wider scale.

**Sivakasi match factories employ 45,000 children and work them 14 hours a day.(Smitu Kothari)**

which comes under the Indian Council for Medical Research. There is also the Central Labour Institute (CLI) in Bombay. Lesser known organisations are the All India Institute of Hygiene and Public Health in Calcutta and the Indian Institute of Technology in Kanpur.

However, the performance of these institutes is by no means satisfactory. Much of their time is spent on detailed medical surveys, rather that a broader social view of occupational health problems. For instance, they often mechanically apply threshold limit values (TLVs), specified for different diseases, to real life situations. These (TLVs), are either prescribed by the ISI or simply borrowed from the West. But it goes without saying that a worker in an advanced industrial country is capable of withstanding much greater dust levels or stress because of far better working and living conditions. Yet ISI tolerance limits are often 10 times those set by international organisations like ILO and WHO.

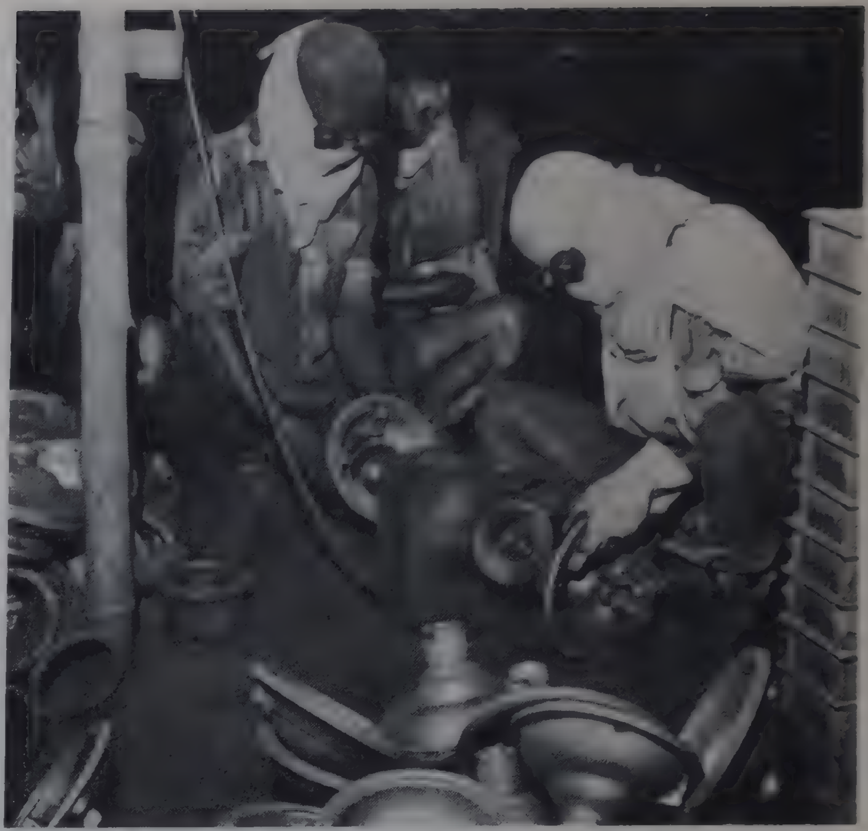
When the NIOH or CLI exonerates a particular firm—invariably unnamed—from not exceeding TLVS, it omits to mention that the health status of the workers is already very bad. In any case, the secrecy with which NIOH and CLI workers conduct surveys, refusing to divulge their findings on the ground that they are the property of the "client", often a company which funds the study, renders them useless to unions or activists who are investigating workers' safety conditions. One copy of the findings is sent to the company and the other to the Inspectorate of Factories in the state concerned. The latter then determines which recommendations are realistically enforceable. For that matter, the NIOH lacks teeth because it can only recommend, not enforce, health and safety measures.

**Industrial management**

If official agencies have shown very little concern for the well being of workers, the attitude of managements is even worse. Over the last 30 years, some 36,000 workers have been reported killed and 6.4 million injured at work in factories, mines, ports, and railways. At the rate of 11 person days lost per non-fatal injury some calculate that 4 million to 5 million person days are lost each year. There is no accurate estimate of the person days lost as a result of illness, but it will run into hundreds of crores a year—many more than those lost to strikes and lock-outs.

The Workmen's Compensation Board pays out Rs 1.5 crore a year only as compensation for injuries while the ESIC doles out another Rs 30 crore. The annual claim on insurance companies for injuries not compensated under these schemes works out to Rs 120 crore. Altogether, the Loss Prevention Association of India estimates that Rs 2,000 crore is the bill to the nation on account of accidents alone, which means that the cost of illness is excluded. This added up, in 1982, to Rs 30 per capita and Rs 150 per family per year.

Unfortunately, few employers, whether in the public or the private sector, are interested in worker safety. Many are guilty of utter callousness. In the slate pencil industry of Mandsaur, any worker who betrays the slightest sign of silicosis is fired on one pretext or the other. According to the law, the worker is entitled to adequate compensation on becoming a victim of this notifiable disease. However, if compensation is claimed the worker is threatened; members of the family who are employed are warned that they can lose their jobs. A disabled person is often paid off cheaply on the condition that no noise is made. And in the event of death, no one can claim anything because there is no medical certificate to prove that silicosis had been contracted.



**Safety practices are rarely followed. Some 6.4 million workers have been injured over 30 years.(ILO)**

The dismissive attitude of the GRASIM management also shows up management's insensitivity. When Padmanabhan's PUCL pamphlet was released and press reports appeared throughout the country, the company went to great lengths to try and prove that the accusations were totally false. It quoted copiously a report by the Madhya Pradesh Pollution Control Board in 1978: "There is no abnormal incidence of diseases in this area and further, there is no evidence to suggest their correlation with the waste discharge of the factory". Incidentally, the board's chief chemist has gone on record to say that the factory had never released mercury in its effluents, while the board's report itself refers to mercury wastes.

GRASIM has also tried to make much of the fact that the Jan Seva hospital in Nagda is well equipped and headed by a renowned surgeon. But the more pertinent fact is that this hospital has no one competent to examine a victim of an occupational hazard. Patients suffering from hemiplaegia are forced to go to an Indore hospital and till recently, periodic medical checks of workers were not carried out. In any case, most of the medical expenses have been picked up by the workers themselves. The management even claims that the employees fall ill because of their "geographical and cultural background, genetic and racial difference".

In the case of asbestosis in the Shree Digvijay plant in Ahmedabad, the practice of dumping asbestos waste outside this factory—children can be seen playing with it—has been defended by the management with "when people need it, they take it" Similar nonchalance was displayed by a manager at the Birla-owned Hindustan Asbestos mine in Roro who said, "No industry can run without dust being generated—there is asbestos dust everywhere, but we don't bother about it."

Activists believe that the entire state apparatus is pro-management. At hearings, it is quite common for welfare officers to arrive with files signed by them on behalf of managements. The statistics bare the truth: in Mandsaur, the Madhya Pradesh Labour Department filed 59 cases in 1979, demanding compensation of Rs 12 lakh. A full three years later, only seven cases had been decided, asking the factory owners to pay Rs 85,000. Even then, the managements had appealed, which meant the dependents had not received a single rupee.

Unless the enforcement authorities take a stricter view of the malpractices committed by factory and mine owners, there is little hope for workers. Punitive measures like the suspension or even cancellation of licences will alone prove effective. Most firms will be quite content to pay the small fines prescribed for violating provisions of various laws, provided their factories continue to work as usual.

## Trade unions

This overview of occupational health in India reveals two tendencies as far as trade unions are concerned. First, in small factory sheds—like the production units of Mandsaur and Sivakasi, with a high proportion of women and child employees—it is futile to expect workers to protest about working conditions. Their jobs are so insecure that the slightest provocation is sufficient to get them the boot. It is not surprising that unions are conspicuous by their absence. But even in the cities, so preoccupied are trade unions with fighting for an increase in wages and perquisites that they lose sight of other improvements which managements can and should make.

A classic case in point is the attitude of trade union boss R.J. Mehta, who is powerful in several big and medium industries in Bombay. His Engineering Mazdoor Sabha is the officially recognised union in the Asbestos Cement Company. But Mehta appears to be totally unaware of the dangers of asbestos fibre. "Yes, we have had a few cases of TB" he told 'Business India' adding: "The wide open spaces at the Mulund plant ensures that dust exposure is maintained at low levels. Besides, most of the time the asbestos worker is an unskilled or a semiskilled worker; where else will he get such good wages? It is difficult for him to find another job." Comments N.L. Gadkari, former chief inspector of factories in Maharashtra: "Workers should realise that an increase in allowances is not a substitute for health and safety measures. Unfortunately, unions always press for extra monetary benefits to compensate for hazardous work."

But at least one victim of asbestosis has decided not to take it lying down. S. Rajagopal joined Hindustan Ferodo, the Bombay-based asbestos company, in 1961 as an operator in the brake and clutch lining department, which uses asbestos powder in a dry process. He suffered from a chronic cough with expectoration and breathlessness, which ESI doctors insisted was asthma or bronchitis. In 1976, however, a municipal hospital discovered that he had asbestosis.

Despite representations to the management, it refused to admit that he was suffering from the disease. He was referred to Dr G.G. Davay, medical inspector of factories, who suggested that it may have been acute bronchitis or a sequel to a past pulmonary infection. Rajagopal even unsuccessfully petitioned the chairman of the British collaborator, Turner and Newall, before resigning from the company because he had to be hospitalised immediately.

He has now filed a writ of mandamus against the ESIC and CLI jointly to compel them to subject him to an examination by experts and submit the report to the high court. The management of Hindustan Ferodo is also cited in the suit. He is claiming payment of an interim allowance during the petition and compensation for occupational disease. The case may well set a precedent in the law relating to occupational hazards.

Hindustan Ferodo has a CITU union — affiliated to the Communist Party (Marxist) — which has raised several issues, including that of two asbestosis deaths in 1982. The previous year, workers went on a seven-month strike which demanded, among other things, better working conditions. Prabhakar Sanzgiri, president of the union, cites how government regulations demand that processes like the cleaning and grinding of cylinders in the carding section be mechanised. Under an agreement with the union, the management decided to import new equipment from West Germany for this purpose.

Union representatives want other improvements: proper ventilation, separate lockers and bathing facilities so that the deadly fibre is not carried home. But the company has resisted these on the ground that they cost too much. "We are often told," says Sanzgiri, "how Sundaram Abex

### United They Stand

The Chhatisgarh Mines Shramik Sangh, led by the well-known Shankar Guha Niyogi, in Dalli Rajahara, has organised 8,000 contract workers in the iron ore mines to win not only better wages but also working conditions. One of the demands, which the union had been agitating for since 1977 and contractors were finally forced to accept, was an eight-hour day. As one worker said, "We had to work 12 hours to 14 hours a day; our children saw us only once a week." Their pre-monsoon hut repair allowance was also raised from Rs 20 to Rs 500 as a result of the agitation.

Niyogi's most startling contribution to workers' health, however, was a campaign to persuade workers to voluntarily give up drinking. He clearly saw that if increased wages was the sole objective of union strife, in Dalli Rajahara this would be swallowed up in gambling and alcohol. Union members who broke the social boycott would be fined Rs 100, of which Rs 95 would find its way back to his wife without his knowledge.

The dramatic outcome of the campaign was the sudden fall in consumption of liquor—and, correspondingly, an increase in savings and visible improvement in the materials used to build homes, which now boast of utensils and charpoys. One worker reported how they used to wear a single pair of shorts and vest formerly because there was no change of clothing: "In fact, when we went to visit our villages, the people would refuse to sit near us because we were so dirty." Some have even freed their mortgaged lands and bought plots in nearby villages.

The union runs four schools itself—having handed over the running of another four to the government. Because of the pressure it has exerted on the Bhilai steel plant, to which its mines are captive, the management has also opened schools for the miners' children. The salaries of the teachers are paid from a common fund collected by the workers. The union has also started the construction of a small hospital and maternity centre. While there was just one water tap in the labour colony which would trickle for half an hour in the morning and evening, which was supposed to serve 4,000 residents, today there is a tap in each mohalla.

(another asbestos company) has a wage cost which is only 17 per cent of manufacturing costs, while it is 28 per cent in Ferodo. I wonder what the working conditions in Sundaram Abex are like."

Workers feel that the ESIC has let them down badly. Those in the Asbestos Packing and Manufacturing Company in Andheri, Bombay, say that they are only checked up twice a year by a municipal hospital as well as by an ESIC hospital in Andheri. However, whenever cases of asbestosis are detected, workers are allegedly retrenched by the company. When workers are not in service, ESIC contributions stop and they can avail of its treatment for only six months. The ESIC provides for compensation of up to Rs 80,000 payable in instalments of Rs 500 a month when workers die in service. If they are sacked, however, or die more than two years after retiring, neither the management or ESIC assumes any liability for the worker's dependents.

Another company in which workers are beginning to assert their rights to better working conditions is Rashtriya Chemicals and Fertilisers Ltd (RCF), the mammoth public sector fertiliser concern in Bombay. Following the death of an 18-year-old worker, John Nathan, in the nitric acid plant in 1982, employees have become very much more aware of the everyday hazards they face. Nathan was believed to have succumbed to nitrogen oxide fumes when he went into the plant to repair a leak. The RCF management, however, maintained that the accident was a consequence of the worker's "foolhardiness" because he had not donned a protective mask.

Dr S.R. Kamat of the chest diseases department of the KEM hospital in Bombay, whose team has been studying air pollution levels in the city, has found that the workers in this fertiliser factory are suffering from lung impairments because of exposure to oxides of nitrogen. Examination of 125 workers found that "those working for a longer period showed a greater frequency of dyspnoea, cough, chest pain and headache".

Duleep Singh, the chairman and managing director, however, has attributed their health complaints to "home habits, smoking and Bombay environment"—a favourite explanation of managements. RCF doctors, according to Duleep Singh, had examined the scars on workers' lungs and believed that these would heal on their own and did not require treatment. He admitted the workers were not "satisfied" with this survey and further tests would be carried out.

A Bombay union group is studying how workers can agitate against nitrogen oxide emissions in the plant, as well as increasing workers' awareness of such problems. In talks held under the workers' education programme, the response has been quite heartening and many employees have come forward to contribute their experiences.

Similarly, the union in Kamanis, a large engineering company in Bombay, is planning to conduct studies on occupational hazards in three separate divisions. Workers have been collecting primary and secondary data and activists are now preparing detailed technical notes. A formal request has been made to the CLI to conduct a noise survey as well.

In Kanpur, the Rashtriya Textile Shram Sangthan and Chemical Employees Union, Unnao, have jointly planned a survey of three textile mills and a chemical plant. To obtain an impartial picture of workers' health, the unions are trying to arrange medical examinations through the Occupational Health Centre in Kanpur, which is under the ITRC. The Bharatiya Bhatta Mazdoor Sangharsha Samiti in Delhi had planned to study the cough, chest pains and breathing problems of brick kiln workers.

Interestingly, when Kanpur textile workers marched to the labour commissioner to protest on other issues some months ago, they spontaneously decided to put up a street play depicting the problems of byssinosis. When 60 to 70 workers were jailed, they continued this health education campaign behind bars to a literally captive audience. However, for every case of worker participation in sorting out occupational health problems, there are a hundred where nothing is done.

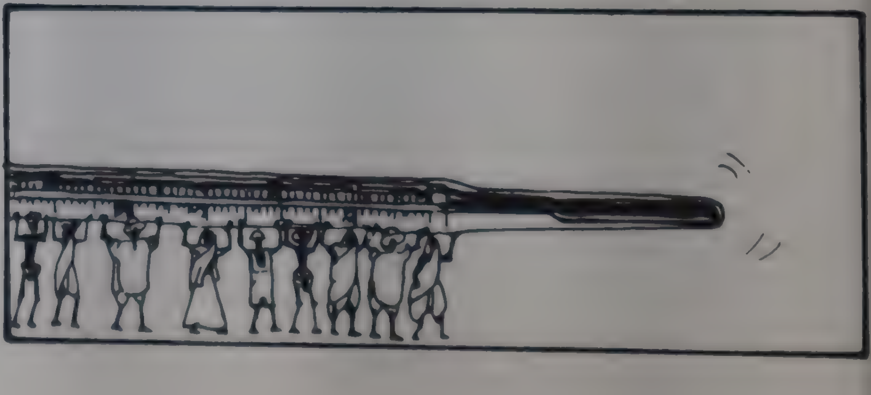
### Emerging issues

Several conclusions can be reached. First, managements, both in the private and public sector, are at best indifferent and at worst callous about their workers' health. Second, the official machinery is hopelessly inadequate. Doctors, whether attached to the ESIC or private practitioners, are not sufficiently acquainted with the problems of social and preventive medicine. Both inspectors and doctors tend to side with industrial managements, if they are not directly in collusion with them. Third, and one of utmost significance, is the fact that workers themselves lack awareness of the risks they are exposed to. Finally, unions too have been remiss about making occupational health an issue so preoccupied are they with economic benefits. Some unions may even perceive concern about occupational health as "anti-labour" since the gut reaction of managements is to close down a unit if too much fuss is made about unhealthy conditions.

Where it has been done, however, the outcome has been most heartening, as the experience of the Chhatisgarh Mines Shramik Sangh amply shows. Indeed, activists point out that the demand for better working conditions opens up new avenues in mobilisation and can lead to further democratisation within unions (see box).

Occupational health is undoubtedly an issue that calls for more union involvement, as well as research by experts and activists. Once unions demand the right to know about dust levels on the shop floor, for instance, it is only a matter of time before they insist on medical experts—appointed by the government, management or themselves—conducting surveys and publicising their findings.

Just as the global environment and development debate centres on the fact that economic growth by itself will not do enough to raise people's living standards, so also does an overview of occupational hazards drive home the point that wages are only part of worker welfare. Almost as important are the conditions in which they labour—in factories, mines and farms.



**The anti-malaria scheme was India's largest health project. But malaria is back with a bang. (WHO)**

# MOSQUITO-BORNE DISEASES

The mosquito is probably the most dangerous insect in India today. All the diseases it carries are spreading rapidly in the country: malaria, Japanese encephalitis, dengue, filariasis and so on. In the last two years, there have been major epidemics of cerebral malaria, dengue and Japanese encephalitis. All talk of eradicating them has stopped and even talk of control has died down to a murmur.

**Malaria**

The National Malaria Eradication Programme (NMEP) claims that the incidence of malaria has been dropping. It, according to official records, went up from about 100,000 cases in 1965 to 6.47 million in 1976 but has since steadily come down and was estimated at 2.16 million in 1982. But are these estimates correct? Studies by the Malaria Research Centre (MRC) of the Indian Council of Medical Research show that the number of malaria cases officially reported by NMEP is only a minute fraction of the actual incidence. According to the projections of the Indian Drug Manufacturers Association (IDMA) 3 per cent of India's population—about 20 million people—should have been affected by malaria in 1980 and 5 per cent by 1990. IDMA's estimate of malaria cases in 1980 was, thus, about seven times the number actually reported by NMEP: 2.89 million. MRC studies show that the actual number of malaria cases in the country may, in fact, be 20 to 40 times higher than NMEP figures.

Investigations by MRC in 1981-82 in the Kharkoda primary health centre (PHC) of Haryana found 7117 cases of malaria whereas NMEP found only 183 during the same period. In Kichha PHC, in Nainital, MRC found 1,784 cases and NMEP only 63—and it detected no case of *Plasmodium falciparum* (cerebral malaria) while MRC found 23. In another study in 1982 the slums of Delhi, MRC calculated an Annual Parasite Index (API) for Delhi of 496.6 based on its own data—in other words, every second slum dweller got malaria that year. The NMEP found an API of only 7.5 for 1982, and over the last 10 years the maximum was 69.13 in 1978.

The number of malaria positive cases per thousand population in one year is the API. This index plays a crucial role in determining anti-malaria operations: areas with an API less than 2 are not sprayed unless there is a special reason to do so. The API also determines which insecticide shall be sprayed and this is an expensive decision: DDT to cover a million people costs Rs 14.01 lakh, HCH costs Rs 28.02 lakh and malathion costs Rs 177.02 lakh. As MRC studies clearly show that APIs calculated on the basis of NMEP data are gross underestimates, the efficacy of anti-malaria operations is highly doubtful.

Even worse, NMEP surveillance is missing out on the seasonal peaks of both malarias. "In fact this apprehension was confirmed in the follwing year (1982-83)," says the MRC report. "In Gadarpur PHC (Nainital), investigations revealed an outbreak of falciparum malaria, and the transmission was so intense that it was comparable to the pre-eradication days of malaria endemicity." One-third of the population in this PHC came down with malaria during the peak months of September, October and November: the API reached 169.4. In the Kharkoda PHC, Sonepat, NMEP had reported only 80 *P. falciparum* cases whereas MRC found 4,971 cases which amounted to a serious outbreak of *P. flaciparum* malaria requiring immediate control measures. The NMEP used MRC data and undertook immediate spraying operations with malathion.

The NMEP data itself shows an alarming incidence of the more vicious cerebral malaria: malaria incidence decreased by 44 per cent between 1978 and 1982 but *P. falciparum* cases decreased by only 14 per cent, and their share in the total rose from 15 per cent in 1978 to 25 per cent in 1982.

Nine states with 43 per cent of India's population account for 70 per cent of all cerebral malaria cases: with 4 per cent of India's population, Orissa alone accounted for 49 per cent of all *P. falciparum* infections and 12 per cent of all malaria cases in 1982. Cases of the deadlier version have multiplied 7.5 times between 1970 and 1976 and an alarmed government has launched a *P. falciparum* containment programme with the assistance of the WHO and the Swedish International Development Authority (SIDA), which now operates in 114 districts with a fifth of the country's population.

What is even more disturbing is that there are now many places in the country where both mosquitoes have become resistant to insecticides, and the *P. falciparum* parasite has become resistant to the main drug chloroquine. Resistant *P falciparum* cases were first reported in the Northeast and since then chloroquine-resistant malaria foci have been found all over India: one each in Bihar, Maharashtra, Manipur, Mizoram, Tripura and Uttar Pradesh, two each in the Andaman and Nicobar Islands, Andhra Pradesh, Delhi, Madhya Pradesh, Meghalaya and Nagaland; four in Assam; and five in Orissa. In several geographic areas, pyrimethamine resistance—pyrimethamine is a drug given when chloroquine does not work—has also been observed.

### Epidemic scares

During 1983, there were many "mystery disease" scares, but most of them turned out to be malaria, as health officials admitted later in Parliament. The worst case of a "mystery disease" was reported from Shahjahanpur district of Uttar Pradesh in October 1983, when 522 people died in August and September. In the 35 most affected villages in two tehsils of Nigohi and Tilhar, with a total population of about 20,000, some 220 people died, six in every village. An MRC survey found that three out of every four slides collected were positive for malaria parasites and 96 per cent of the positive slides revealed *P. falciparum*. The survey was conducted after the state health department had already undertaken mass treatment in the area.

Less than two months later, in mid-December, newspapers reported yet another terrifying 'mystery disease' affecting two villages in Mathura district, Nangala Mora and Ramnagar with a total population of 1,600. Some 41 people died, five in one day in one village. Drainage is practically non-existent in the two villages and flooding was particularly severe in 1983: waist-high water for two to three months in Nangala Mora, with even drinking water wells contaminated. A team of Agra doctors found that common diseases like pneumonia, asthma and TB had killed off the people. Almost every resident examined had a history of malaria.

**Impact of canal irrigation on malaria**

| | | **Total Malaria malaria cases** | ***P. falciparum* malaria cases.** |
|---|---|---|---|
| Villages with canal irrigation (Meerut) | June | 57 | 1 |
| | October | 81 | 50 |
| Villages without canal irrigation (Gurgaon) | June | 10 | 0 |
| | October | 9 | 3 |

Source: Malaria Research Centre.

Despite these well-reported and confirmed cases the NMEP's data collection machinery reported only 175 cases of death by malaria all over the country between April 1983 an January 1984 and according to an NMEP official only one death from Uttar Pradesh.

The main cause of chloroquine resistance is the government's own containment strategy. In the mid-70s when the mosquito had first begun to show resistance, the government switched from an insecticide-based preventive strategy to a drug-based curative one and made chloroquine available in large quantities. Unfortunately, the drug overkill led to tougher germs. MRC studies in Delhi, Haryana and Uttar Pradesh have found that the current chloroquine dose is no longer as effective as it used to be. Fewer than 5 per cent of the PHC's have been surveyed for resistant cases, but in those that have been, resistant cases have been found.

It is important to mark out drug resistant areas so that patients can receive proper doses: an inadequate dose can greatly accelerate the emergence of drug resistance. The combination of sulfamethopyrazine and pyrimethamine is very effective and simple to administer. But if indiscriminate use is made of these drugs, the parasite will become resistant to them much before the country turns to them in a big way.

Resistant mosquitoes and bugs are not the only reason why the anti-malaria programme is floundering. Environmental changes like those caused by canal irrigation, which create mosquitogenic conditions, are another major cause. Comparable villages in Meerut in Uttar Pradesh and in Gurgaon in Haryana were studied. The Meerut villages were within 2 km of irrigation canals, while the Gurgaon villages were at least 40 km away from them. The canal-irrigated villages of Meerut had six times as many malaria cases in June—and nine times as many in October—as did the Gurgaon villages. They also had a higher number of *P falciparum* cases: 50 as against three.

The study concluded that untidy and defective canal irrigation led to waterlogging and the formation of puddles which were good breeding grounds for the mosquito. Elsewhere, an environmental impact study on the Navagam dam being built on the Narmada suggests that the proposed irrigation system could add to the already high incidence of malaria in the region.

## Japanese encephalitis

Japanese encephalitis (JE) rarely attacks human beings but when it does, it kills between 25 and 50 per cent of those affected. Every third survivor is left with parting gifts like motor paralysis and cerebral and speech defects. Cases of JE are being reported from newer and newer areas in India: in 1982 the dreaded virus was noticed in Goa for the first time, indicating that it is no longer restricted to the eastern and southern states.

The situation is no better in endemic states. Compared to 1979, five more districts in Andhra Pradesh were affected by JE in 1981 and two more in 1982. Available figures show that some areas affected earlier in Karnataka had serious outbreaks in 1982. The Kolar and Mandya districts of Karnataka have suffered repeated epidemics. In 1982 West Bengal was rocked for the fifth time since 1973 and the number of deaths increased to 555. Students from the Indian Institute of Technology at Kharagpur fled their hostels in panic. Some 14 persons died in the Kharagpur area and even though the medical officials of the institute said that there was no cause for panic, the students were unimpressed.

In the north, Uttar Pradesh has been subjected to fluctuating bouts of JE. After a lull in 1979— only 72 deaths—the toll rose steeply to 530 in 1980, before dropping to 199 in 1982. During 1983 a number of states reported JE deaths—Andhra Pradesh, Bihar, Karnataka, Tamil Nadu and Goa was again affected and so were Kolar and Mandya districts in Karnataka.

It has been established that JE has spread with irrigation. The disease is carried by mosquitoes, which prefer to breed in paddy fields with standing water. In West Bengal and Tamil Nadu, a particular species of mosquito, which carry JE are now resistant to DDT; the authorities are banking upon malathion. To contain outbreaks, the Centre has asked the states to spray BHC/DDT 2 km to 3 km around a JE case and undertake immediate malathion fogging. But fogging machines are never available in the rural areas and even in towns are generally used in the richer sections. Children get priority in anti-JE vaccination. But JE has different patterns in different areas. In the 1950s, when it was occasionally reported from south India, it was known to affect only young children but in the newly affected areas almost all age groups are affected. In Goa most of the victims belonged to the 37-68 age group. If only the under-15 population are to be immunised, about 816 million vaccines would be required per year. At the moment, the government plans to produce only 200,000 vaccines annually by 1986.

Another catch is that the vaccine must be given at least one month before the epidemic, which means that the forecasting mechanism of the health department must be efficient. To this end the ICMR is planning to set up a model surveillance system during the Seventh Five Year Plan to provide advance warning of impending outbreaks of JE in two states of India.

**Incidence of Japanese Encephalitis in India**

| Year | Cases | Deaths |
|---|---|---|
| 1978 | 7463 | 2755 |
| 1979 | 2845 | 926 |
| 1980 | 3478 | 1436 |
| 1981 | 3894 | 1167 |
| 1982 (prov.) | 3516 | 1261 |

Source: Ministry of Health and Family Welfare

## Dengue

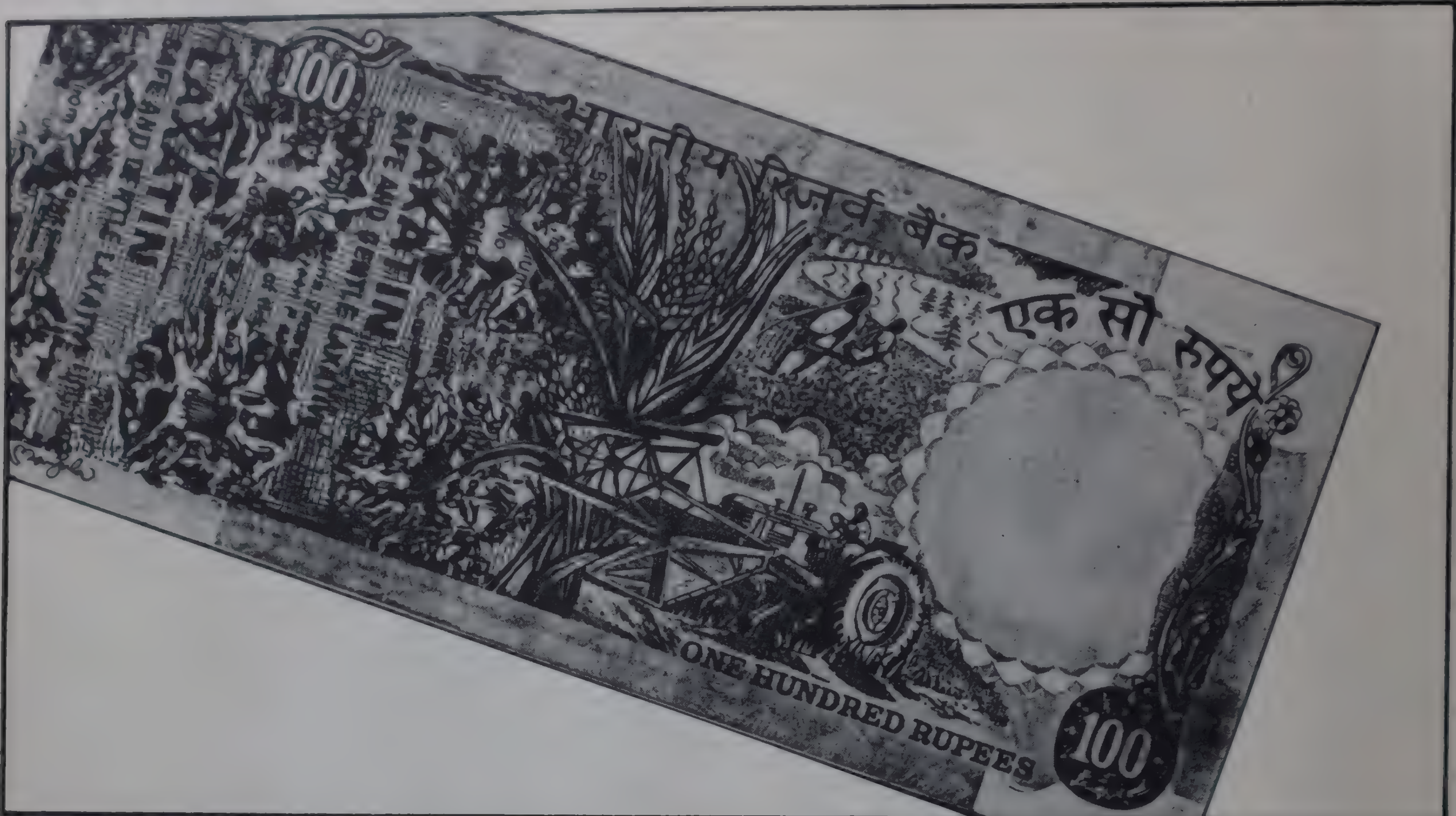
Reports of viral fever raging in various Indian towns have in recent years become a common feature of Indian newspapers. In many cases the predator has turned out to be dengue, a virus spread by the white-striped mosquito *Aedes aegypti*, found mainly in urban and semi-urban areas and breeding in clean water sources. The first laboratory-proven outbreak occurred in Calcutta in 1963 and several epidemics have been reported in Delhi, Hardoi, Kanpur, Asansol, Calcutta, Gwalior, Saugar, Jabalpur, Jaipur, Pune, Surat and other towns. The incidence of cases has been a high 200 to 300 per thousand every time.

In 1982, there was an explosive outbreak of dengue fever in Delhi which affected hundreds of thousands of people in the three months from August to October. Investigations in an important murder case came to a halt as the entire staff of the Central Forensic Science Laboratory came down with fever. A heated Parliament discussed whether the epidemic would pose a threat to the Asian Games scheduled to be held in the city later that year. One paranoid MP even wondered whether there was a foreign hand in the outbreak.

As the disease spread, the city's pharmacists ran out of paracetamol tablets and distributors had to airlift stocks. A study by the National Institute of Virology (NIV) in Pune and the National Institute of Communicable Diseases (NICD) in Delhi at the end of the epidemic concluded that Delhi has now become endemic for dengue. Delhi had suffered major outbreaks of dengue in 1967, 1970 and 1974.

In 1983, dengue again hit the city and in November, 'India Today' reported a survey of the NICD showing that

**A pond being sprayed with larvicide to kill mosquitoes.(India Today)**



## Prescription for Greed

Diarrhoea is a common complaint in India. In one prescription for acute diarrhoea, a doctor prescribed Lomomycin, an antibiotic, Lomotil, which reduces motion frequency, Pecto-Fab, to solidify the stool, Baralgan, a pain-killer, Flagyl, used against amoebiasis and giardiasis, and Pentalmine, a drug used against worms. The most important part of the treatment, oral rehydration to prevent dehydration was missing. One glassful of water with a pinch of salt, sodium bicarbonate and two teaspoons of sugar is all that is needed. Most diarrhoeas of this kind are cured by the third day.

Overprescription, though perhaps not on such a scale is the bane of the health scene today and it would not be too much of an exaggeration to state that it occurs in 80 per cent to 90 per cent of the cases.

Overprescription is not just costly, it can be downright harmful. Because of the prevalent practice of prescribing antibiotics right and left, even for self-limiting viral infections, patients build up resistance and antibiotic resistance is now a serious health problem in developing countries. Steroids give instant relief but if used too often and casually, as is the practice, they can cause cumulative toxicity in the user. In India, Rs 10 crore worth of medications containing anabolic steroids are sold every year, and the claim is that they develop stamina and build muscles. But their basic component is testosterone, a derivative of the male sex hormone, and the side effects for women are a deepening of the voice, acne, baldness, hairiness and shrinking breasts.

Wholesale duping of patients takes place with vitamins and tonics. Tonics and vitamin formulations account for 25 per cent of total drug sales in India. Even for mild vitamin deficiency, heavy doses are prescribed. These are sometimes up to 1,000 times above the recommended daily allowance of vitamins. Excess vitamins are simply flushed out of the human body in the urine. This is money literally going down the drain.

Another aspect of the emerging drug culture is "injection mania". Patients regard injections as a vital part of medication; and the costlier the better. Vitamins, calcium, steroids, anabolic agents are commonly used in injections. Saline bottles are popular because people believe that a saline injection is given to a seriously ill patient. Doctors defend themselves by saying that patients demand injections. Sometimes, they say, even if the drug makes little difference, the satisfaction of getting an injection acts as a placebo. At other times, they claim, fast-acting injections are given because the person is too poor to afford losing time at work.

Unnecessary surgery is another face of the drug culture. A committee for enquiry into health services in Maharashtra has observed that caesarean deliveries are excessively common. Firstly, they bring in more money, and secondly, they are quick, against the 14 hours to 24 hours a normal delivery takes. Normally caesarean deliveries are 2 per cent to 5 per cent of the total but in some private hospitals they are now as high as 30 per cent to 35 per cent.

The government looks on complacently at these expensive developments. However, some efforts have been made, like the decision banning the manufacture and sale of 22 fixed-dose combination drugs. But these efforts too have been half-hearted. Now as far as the Central government is concerned, it is up to each state government with its own system of monitoring the implementation. Ultimately, as Dr S.S. Gothoskar the drug controller of India admits, it would be up to vigilant consumer groups to enforce the law. Dr Mira Shiva of the Voluntary Health Association of India feels that the minimum that the government could do is to make sure that notifications from the ministry, such as the ban on 22 combination drugs, are sent to the Monthly Index of Medical Specialities (MIMS) so that medical practitioners, who refer to it for the latest medicines, are informed. But the brand names of the 22 banned drugs have still not been widely publicised. Dr Shiva says the MIMS continues to carry these combinations in its list of medications, without warnings.

Dr Shiva's point is reiterated in the Kerala High Court Judgement of May 1983 on the ban of harmful drugs; the judges have said that brand names corresponding to the formulations banned by the government must be made known to the public so that people are alerted to their dangers and do not buy these drugs.

An additional factor in India is quality. On the government's own admission, 17.5 per cent of drugs manufactured in the country are sub-standard or spurious. This figure represents only samples from drugs manufactured in the small-scale sector, which accounts for just a fifth of total drug production. It is clear that without a strong consumer movement just banning drugs through government notification will not work. Nor will it stop the overprescription racket.

nearly one-third of the city's population had fallen prey to the fever over the three previous months. An unseemly controversy broke out between NICD and many physicians in Delhi, who refused to believe the former's claim that the 1983 viral fever too was dengue. They argued that the fever in 1983 had different manifestations from that in 1982—a clear indication that facilities for prompt diagnosis of the disease still do not exist.

The cause of the outbreak was also a matter of debate in 1982. Many people were quick to blame the thousands of migrant labourers who had streamed into the city to work on Asiad projects. As dengue is essentially an urban disease, it is unlikely that rural migrants could have included many dengue cases. It was also argued that these thousands of poor households, living in ramshackle makeshift conditions, must have stored their water needs in small pots, not having access to water taps, and this must have provided thousands of breeding places for *Aedes aegypti*, which breeds prolifically in clean water.

But later evidence has not shown this to be true. Dengue is the result of improper urban planning, inadequate control over construction activity which blocks drainage and creates puddles, inadequate drinking water supply which forces people to store water, overhead water tanks which are seldom cleaned, discarded cans and plastic bags in which water can collect and a total lack of public hygiene and health education.

A survey of overhead tanks in Delhi carried out by the

Sanjay Acharya

**Goitre**

Goitre, the unsightly swelling of the neck because of iodine deficiency is now understood to be much more than a cosmetic disease. A study conducted in Uttar Pradesh by scientists of the All India Institute of Medical Sciences (AIIMS) found that one out of 25 babies born to goitrous mothers suffer from brain damage and mental retardation (cretinism). AIIMS scientists estimate that 19,000 children born in the Terai districts of Uttar Pradesh every year are destined to be mentally retarded and approximately 80,000 across the country.

Government estimates earlier put the population exposed to the risk of goitre at 120 million with about third of this actually suffering from it. With the identification of new goitre-affected areas, the Nutrition Foundation of India (NFI) puts the exposed population at 170 million. And AIIMS scientists believe that the actual number may be a high 300 million—nearly half of India's population—with goitrous people numbering over 60 million.

In three districts in Uttar Pradesh, two in Bihar, one in Madhya Pradesh and all in Mizoram, more than half the population suffers from goitre. In villages surveyed by AIIMS in Gonda district of Uttar Pradesh goitre cases constituted between 50 per cent and 80 per cent of the population and in Deoria district between 50 per cent and 90 per cent.

The Himalayan foothills and the adjacent plains stretching from Kashmir to the Naga hills are the world's most intense goitre belt. Of late the disease has also been detected in what were earlier supposed to be non-goitrous areas: the Chotanagpur plateau of Madhya Pradesh, the Aravalli ranges in Rajasthan, the Narmada Valley in Gujarat, tribal areas of Andhra Pradesh, the higher reaches of the Western Ghats, the tea estates of Kerala, Bombay city, Delhi, and the districts of Aurangabad and Pune in Maharashtra. A recent survey in Sidhi, Sarguja, Shahdol and Raigarh districts in Madhya Pradesh found 2.29 million cases of goitre, over half of whom were tribals.

As iodine is essentially obtained from the environment—from drinking water and from the soil, which plants pick up and provide to humans through food—there is reason to believe that the new goitre belts being found in the country, in Madhya Pradesh for instance, are linked to environmental changes like deforestation and increased floods and soil erosion. Floods leach the iodine out of the soil. The AIIMS team reports that, in Uttar Pradesh, "Goitre is most noticeable in the flood prone hamlets nestled particularly along the bends of the river."

In one village on the banks of the river Sarayu, which is regularly flooded, over 80 per cent of the population and over 93 per cent of school children were goitrous and most were severe cases of goitre. Mental retardation and deafmutism associated with severe environmental iodine deficiency was present in 4 per cent of the population. But in another village, where there were no recurring floods, goitre prevalence was 50 per cent and most cases were of a mild degree. Poverty and malnutrition are extensive in these goitre-prone areas and play an important role.

An NFI study points out that there is considerable circumstantial evidence to show that polluted water supply could aggravate goitre in endemic areas and recommends that goitre-prone areas be included in safe drinking water supply programmes on a priority basis. In fact, goitre is the easiest of known diseases to prevent: iodised salt can control it. The National Goitre Control Programme launched with great fanfare two decades ago, was to provide iodised salt to all affected areas but till 1979-80 only 15 per cent had been covered.

Twelve plants for manufacturing iodised salt have been set up at Khargoda in Gujarat, Sambhar lake in Rajasthan and Howrah in West Bengal with aid from UNICEF. These have an annual installed capacity of 3.8 lakh tonnes. Even though the total requirement of iodised salt in the country is something like 7 lakh tonnes, only one lakh tonne is produced. This often creates ridiculous situations, as in Mizoram, where sale of uniodised salt is banned but where not enough iodised salt is available.

"Administrative incompetence, lack of coordination between various agencies involved, and commercial and vested interests have apparently combined to wreck the programme," says C. Gopalan, a former director-general of the ICMR. "Unless health, nutrition and welfare programmes are executed in all seriousness, with a sense of urgency and dedication, the present drift will continue."

MRC in November 1982 showed that they were major sources for the breeding of the dengue mosquito throughout urban Delhi, including rich and middle class colonies like Hauz Khas Enclave, Lodi Colony and Ayurvijnan Nagar (ironically, a residential colony of the All India Institute of Medical Sciences). The study states: "Most of these (overhead) tanks were poorly maintained. They were not cleaned for a long time, the lids were broken or left open, some of the tanks were not in use and had rainwater. The house owners of these tanks were ignorant or disinterested, and some of the owners were taken aback at the quality of stored water they were using."

### Fatal Felling

Kayasanur is a small village in Shimoga district of Karnataka. It was here in 1956 that the Kayasanur Forest Disease (KFD), as it was later to be called, was first noticed in four forest workers. The symptoms were similar to those of Japanese encephalitis: rising fever, severe headache, body pain and subsequent bleeding from the nose and anus. The only treatment then, in the absence of any vaccine, was to prevent dehydration and hope for the best.

Hopes that the disease would remain confined to the original area were dashed when between 1971 and 1976 four new trouble spots appeared in Uttar Kanara and Shimoga districts. In 1983 KFD struck with redoubled venom in Dakshin Kanara district, killing 139 people out of the 1,500-odd affected. Over one and a half decades, then, the disease had spread from north to south Karnataka, from a 200 sq km patch in Shimoga district to a 10,000 sq km area. The fatality rate is 5 per cent and the survivors are incapacitated for a long time.

KFD is associated with the felling of forests. The National Institute of Virology (NIV) in Pune found that small animals like shrews, rats and squirrels carry the ticks which harbour KFD. When the forests are cleared these animals are driven away and the ticks fasten on other beings, beginning with monkeys and going on to forest labourers, farmers and others. At Kayasanur and the four other areas where the disease struck, the forest had been cleared for coffee plantations.

In 1983, for instance, the infection flared up around Patrame village, on the border of Nidle state forest which covers a 32 km spur of the Western Ghats, and which has villages on both flanks. About 400 hectares was earmarked for a cashew plantation clearfelling for which started in late September. Towards the end of October, the labourers and the villagers noticed a few dead monkeys. In early December, two children and a man, all from the same family fell sick and died. The first officially recorded case was on December 27.

Initially the cases went unreported because of superstition and were put down to angry spirits and the ghosts of dead cobras killed during the felling. As the disease spread, the authorities were pushed into converting the Nidle primary school into a hospital, rushing mobile medical units, and printing 25,000 pamphlets in Kannada explaining the nature of the disease and asking people to avoid the forests; if they couldn't they were to cover themselves well and have a hot bath on their return. Tree felling was stopped. By the first week of February the epidemic appeared to have subsided.

Today, there are at least 15 species of ticks which can transmit the KFD virus. NIV investigations have indicated that adult ticks can infest larger ruminants like sambar deer and the Indian bison and the KFD area had a fair number of these animals 30 years ago. Now poaching has put paid to them and the state government probably feels that with their disappearance the ticks will also vanish. As is obvious, this has not happened although few studies have been made to see if the ticks can find new hosts in domesticated cattle, cats and dogs.

The KFD scare has serious implications. Research has revealed 41 viruses spread by arthropods—insects such as mosquitoes, sandflies and ticks. Twelve are known to cause diseases in human beings in India, which include the mosquito-transmitted Japanese encephalitis, dengue, chikungunya virus and KFD.

Daily new populations of *A. aegypti* were emerging from these tanks and as they also bite during the day unlike many mosquitoes, the transmission of the disease was intense. And yet all that was needed was to periodically clean the tanks and close the lid tightly so no mosquitoes could breed inside.

The NIV in a recent survey of the Dehu town group near Pune found several localities heavily infested with *A. aegypti* breeding in vessels used to store drinking water: iron drums, cement tanks and mud pots. Many towns in Maharashtra which were earlier known to be free from *A. aegypti* have during recent surveys been found infested with this mosquito. A survey in Pune city in 1983 found 21 out of 26 localities infested with *A. aegypti*, five for the first time. If all vessels containing water are periodically emptied and refilled or treated with larvicide, the problem could be easily controlled.

Dr A.N. Roychowdhury, director of NICD, told 'India Today' that the outbreaks of dengue are also due to the sudden changes in urban lifestyles. "Almost every house has a desert cooler now" he said. "Automatic defrost refrigerators and plastic bags too have compounded the problem." *A. aegypti* can breed in water in desert coolers and in plastic trays kept beneath the icebox in the refrigerator.

The Union health minister was able to comfort Parliament by pointing out that dengue is a self-limiting disease and does not kill. But this situation may not remain so for long. All over the western Pacific and Southeast Asia a variant of dengue fever—the dengue haemorrhagic fever (DHF)—has become a major health problem since it was first recognised in the Philippines in 1953 and in Thailand in 1958. The disease has now become one of the 10 leading causes of hospitalisation and death in children in at least eight Asian countries.

There was one outbreak of DHF in India—in Calcutta, from 1963 to 1965. Since then only sporadic cases have been reported. NIV investigated, for instance, six cases of dengue deaths in Ernakulam district which had haemorrhagic tendencies. On the whole, India has an average of 1,000-5,000 reported cases of DHF every year with a case fatality rate of 0.5 per cent.

There are four types of dengue viruses—all found in India—and some scientists believe that only serotype 2 (DEN-2) causes DHF. But there are others who believe that all four viruses can cause DHF—a first attack by a dengue virus does not cause the haemorrhagic syndrome but a second attack could. Some scientists even believe that the first attack need not be dengue, but of a similar virus like Japanese encephalitis. Many examples tend to confirm this thesis. Cuba, for instance, has had several dengue epidemics but in 1981 had its first outbreak of DHF. No other Caribbean island has reported DHF.

Early diagnosis and treatment of DHF is important to thwart death. India appears to be ill-prepared and dengue is still mostly reported as a viral fever or a fever of unknown origin. Says a WHO report: "The main constraint for India is shortage of adequate diagnostic facilities and low awareness among clinicians of symptoms associated with DHF." Research is being undertaken on a dengue vaccine but a vaccination programme will not be easy to carry out because people will have to be vaccinated against all the four viruses

## Folk Tales

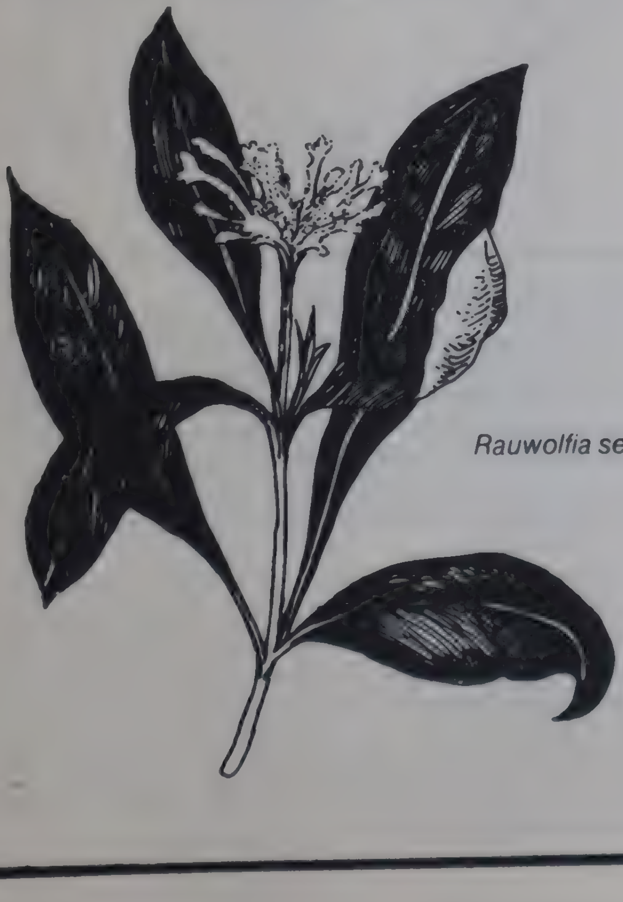
Folk medicine in India is as old as the Ramayana. It is used to treat not just minor ailments but also serious ones like paralysis, blood pressure and asthma. However, not many authentic documents are available to show the extent of its use in the community. A survey of a rural community conducted in 1977 shows that 79 per cent of illnesses were treated with folk medicine—64 per cent by local healers and 15 per cent through treatment at home. Since April 1979, Bharatiya Vidya Bhavan, Bombay, has been conducting a survey of Household Remedies and Medical Relief System. A preliminary analysis reveals that there exists a lot of information on the use of herbs and kitchen ingredients for common ailments.

Efforts are being made by the Academy of Development Sciences (ADS) in Maharashtra to document herbal knowledge available with local healers and tribals. It has found that nearly 50 per cent of the ailments prevailing in the area are being successfully treated with the help of locally available herbs.

Folk medicine deserves more attention and effort. The positive aspects—its decentralised nature, easy availability of medicines, cultural acceptability—need to be reinforced. Most important, it reduces dependence on imported and costly medicines.

Several voluntary efforts are being made to strengthen the system at the local level. Raigarh Ambikapur Health Agency (RAHA) in Madhya Pradesh Deenbandhu, Medical Mission in Tamil Nadu, Health for the Millions Project (HFM) in Kerala, Swallows in India Project, in Rajupeta Andhra Pradesh are some of many non-governmental health projects using folk medicine in primary health care. Village-level workers of the Deenbandhu Mission use only herbal medicine to treat a common ailment. ADS is trying to bring about active interaction between the tribal and the scientific tradition of ayurveda and modern science through camps and health education classes. Several individuals also work in tribal areas, striving to get the invaluable lore down on paper. But, by and large, both governmental and non-governmental agencies have neglected this vital area. State governments do not even maintain a register of traditional healers nor of folk remedies, as they do with qualified medical practitioners and official drugs.

RAHA, Deenbandhu and HFM projects have their own medicinal plant plots and nurseries. Their village level workers grow a few medicinal plants in kitchen gardens and encourage people to plant the herbs themselves. ADS does the same at the local level and on a broader scale ADS hopes to influence the state government by submitting an integrated resource development plan for the whole taluka keeping in tune with the culture and lifestyles of the people of the area. Another tribal based health agency from Maharashtra, the Lok Shikshan Mandal, has been encouraging tribals to cultivate plants. Some of the herbs are later used in their ayurvedic pharmacy in a tribal village.



*Rauwolfia serpentina*

**Ayurveda means the science of life. Herbal ayurvedic medicines being prepared near Coimbatore. (WHO)**

Systematic efforts to study medicinal folklore probably began with the first survey of medicinal plants in India carried out from 1926 under R.N. Chopra. Based on that the Council for Scientific and Industrial Research, New Delhi, has published a Glossary of Medicinal Plants in India. Many botanists and social anthropologists have studied the medicinal flora of the Indian countryside and have documented the plants available in many parts of the country. But the resource base is threatened with massive deforestation and replacement by timber plantations. In the Himalayas, many medicinal plants are being collected so extensively that they are being driven to extinction. Government efforts to promote cultivation of medicinal plants too is being done mainly with a view to enhance export earnings rather than to conserve the resource base.

There is a great need for clinical research, as in China. For instance, Chinese scientists studied the effect of a traditional herbal preparation on viral pneumonia in 3,000 children. In India, even among the few clinical trials that have been conducted, common diseases like asthma, chest infections, TB, leprosy do not figure very frequently, as do complaints like general weakness, old age related problems, vague gynaecological complaints and cancer. The trials generally involve drugs already marketed by some large company. The International Institute of Ayurveda in the Silent Valley and Captain Srinivas Marali Research Institute in Madras are among the few voluntary agencies which are researching folk medicine.

## Alternative control

The failure of pesticides has thrown vector control into a state of crisis and the need to develop environmental control techniques is being felt all over the world.

*Culex quinquefasciatus* is a mosquito that carries the filariasis disease everywhere it goes. It breeds in polluted drains, ponds, stagnant pools and streams and dirty water collected in tanks, barrels, tins and other human-made containers. There are a lot of such breeding places in India which is the main reason why the number of people at risk from filariasis has grown from 25 million in 1963 to 304 million at present. A WHO document states gloomily: "The problem is on the increase because of unplanned growth of towns and cities without proper drainage."

Clearly, a gigantic operation clean-up is necessary. An exemplary start has been made by the Vector Control Research Centre (VCRC) in Pondicherry. For three years, the VCRC toiled relentlessly at washing the city's water and sewer systems clean: sea water was used to flush 50 km of previously clogged drains, killing off mosquito eggs; stagnant water pools were filled in; fish were let loose in open wells to feed on the insects; the single biggest breeding ground, a 200-hectare swamp was reclaimed, afforested and turned into a public park. The result is astounding: where 10 million mosquitoes used to hum above Pondicherry, now less than one per cent of that survive. Where a person would be stung a thousand times a year by Culex — 1,500 bites are needed to catch the infection—he or she is now attacked a mere 15 times every year. "All that VCRC has done is to manage the sanitation and the environment in close cooperation with the municipal, health and town planning authorities," says VCRC Director P.K. Rajagopalan. The costs of the exercise have not been very high.

The key to the success was public education. VCRC officials and workers discovered quickly enough that they gained the trust of the people if they listened sympathetically to woes unconnected with mosquitoes and filaria. The complaints were promptly referred to the relevant government officials and agencies for follow-up. The main stumbling blocks were the well-to-do who seemed to think that the VCRC and municipal staff were their servants. As the VCRC annual report says: "While the VCRC has obtained full cooperation from top officials and economically weaker sections of the society, the middle level officials and the nouveau riche continue to be non-cooperative and actually hinder programme implementation."

The programme ends in 1985, when the municipal authorities will take over the job. There are some doubts whether they will approach the task with the same diligence and application that VCRC has, because their past record in this regard is not encouraging. Also, they were reported to be considering playing the old game of arming themselves with laws to summarily demolish new unauthorised constructions—a throwback to the ancient habit of blaming all disease on slums—without making any effort to see that if the slums have to come up, they do so in environmentally sound conditions. It would indeed be unfortunate if environmental control of mosquitoes became an excuse to bulldoze slums.

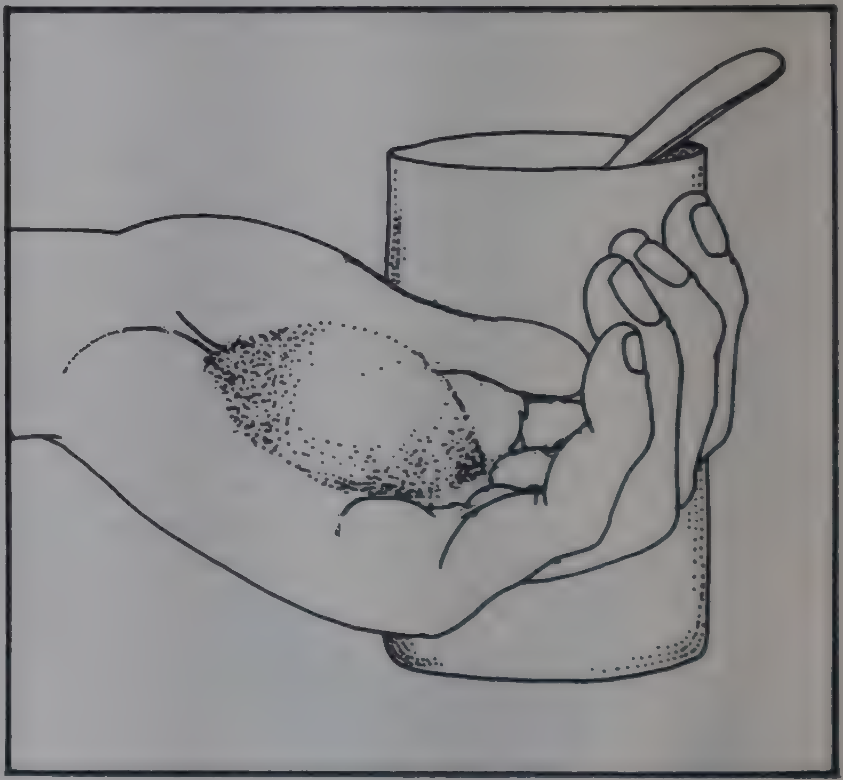
The VCRC has been less successful in four coastal villages

### While Thousands Die ....

Diarrhoeas and dysenteries are never noticed by the media until they become a raging epidemic. One such antibiotic-resistant epidemic struck West Bengal in the first half of 1984. Even in diarrhoea-familiar West Bengal, the virulence with which this epidemic affected people was unmatched. In four months it was raging across entire West Bengal, 13 districts of Orissa, Cachar district of Assam and parts of Tripura.

Nearly 90,000 people were afflicted and 3290 died—over 2900 in West Bengal. The victims were overwhelmingly children below four years of age. The first death occured in late February. But the state government, slow to realise that an epidemic was developing, did not move to clean water sources and provide effective drugs until 129 people had died by April. When the epidemic broke, neither primary health centres nor district hospitals had enough oral rehydration packets, or substances to purify water. No programme to teach oral rehydration therapy at home had been undertaken.

Confusion prevailed amongst scientists. The National Institute of Cholera and Enteric Diseases in Calcutta told journalists after the epidemic had begun to subside, that the bacteria causing the disease differed from state to state. The disease was not spreading from one state to another but new strains of virulent antibiotic resistant bacteria were being generated by local ecological factors. It had been earlier assumed that the disease had spread from Bangladesh to West Bengal and from there to other states. The different strains found in Orissa and West Bengal were all resistant to potent antibiotics like ampicillin, tetracycline and chloromycetin, probably because of the over-



### ....There is Instant Therapy

A pinch of salt and a scoop of sugar. That is all it takes to cure diarrhoea or, more precisely, the dehydration which leads to death. In its more sophisticated form, it is a cocktail made up of water, glucose, sodium chloride and other sodium and potassium salts. This is Oral Rehydration Therapy (ORT), a treatment that can take place at home, the discovery of which the Lancet called "potentially the most important medical discovery of the century".

Diarrhoea kills nearly a million poor and malnourished children every year and the government should have jumped at the chance to spread the good word about such a cheap and effective treatment. However, it twiddled its thumbs for over a decade after ORT was discovered in the late 1960s, and formulated a diarrhoeal diseases programme only in 1982, after big publicity by international agencies like UNICEF. The Indian programme is based on the manufacture and distribution of packets of standard ORT salts.

prescribing of these medicines. Last resort drugs like gentamycin and kanamycin were effective, but very expensive to procure in large quantities.

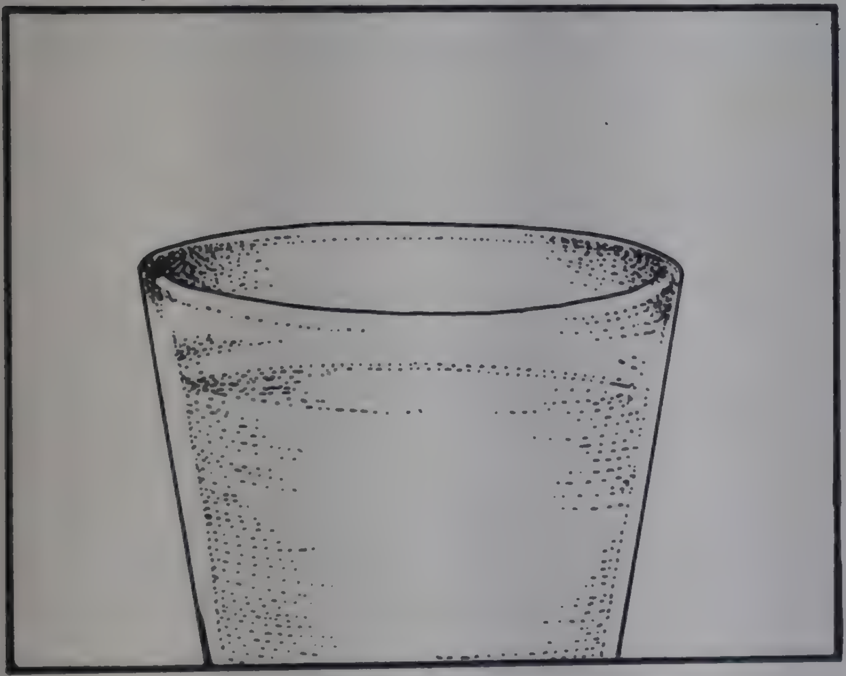
Nobody is still fully aware of the ecological factors that led to the epidemic. A drought had lowered the water table too low for tubewells to provide clean water. Villagers were, thus, forced to use contaminated pond and open well water. But there were paradoxes. Samples of water sources from affected areas did not contain the virulent strain. Some scientists even suggested that the infection could be airborne.

This was not the only epidemic that struck India in 1984. Towards mid-1984, a dysentery epidemic erupted in Bastar, which claimed about 450 lives by October. The government had by then admitted only 176 deaths. Again, administrative neglect had aggravated the situation. Because doctors are reluctant to serve in remote, forested Bastar, 67 posts in government health centres in the district are lying vacant. Consumption of polluted drinking water probably contributed to the spread of the disease. The wastes of the Bailadilla iron ore mines, for instance, pollute the Sankhini river on which thousands of tribals depend for their drinking water. The river becomes red with the pollution.

In Ahmedabad, the capital of Gujarat, an epidemic of hepatitis-B created near panic conditions in late 1984. By August 500 people were dead in the city and thousands lay ill, as hawkers were banned and people became scared to take water in public places. As the epidemic spread to other towns of Gujarat, health authorities helplessly debated whether the disease would strike Bombay. Fortunately, it didn't.

**Diarrhoeas and dysenteries thrive in conditions of poverty, insanitation and polluted water.(WHO)**

**A scoop of sugar, pinch of salt, added to one glass of water, taken several times a day is all that is needed to cure diarrhoea — which kills nearly a million poor and malnourished children every year.**



The 1983-84, 7.5 million packets were supplied to the states and each village health guide also got 80 packets for distribution. But this is hardly adequate since there are at least 94 million children in the 0-4 age group who risk two bouts of diarrhoea every year and at least 188 million packets would be required. But no more than 10 million packets are produced—the Indian Drugs and Pharmaceuticals Ltd making half of this—and by 1990 the production capacity is expected to be only 40 million packets.

Several voluntary health groups like the Voluntary Health Association of India (VHAI) argue in favour of a different approach: a home-based programme based on the pinch of salt and scoop of sugar. This alternate approach would help to demystify diarrhoea treatment and make it accessible to people who cannot afford packets. The important thing with ORT is that it should be undertaken as soon as the diarrhoea begins so that the child never reaches a stage of dehydration. Latest research shows that even rice gruel with salt works well, which is, in fact, a traditional therapy for diarrhoeas in many parts of India. The trouble with this approach is that it does not mean promoting industrialists.

VHAI has collaborated with groups like the Kerala Sastra Sahitya Parishad and the Medico Friends Circle in an "operation diarrhoea": it sent some 10,000 pamphlets to West Bengal during the 1984 epidemic and led campaigns against harmful anti-diarrhoeal drugs like Lomotil.

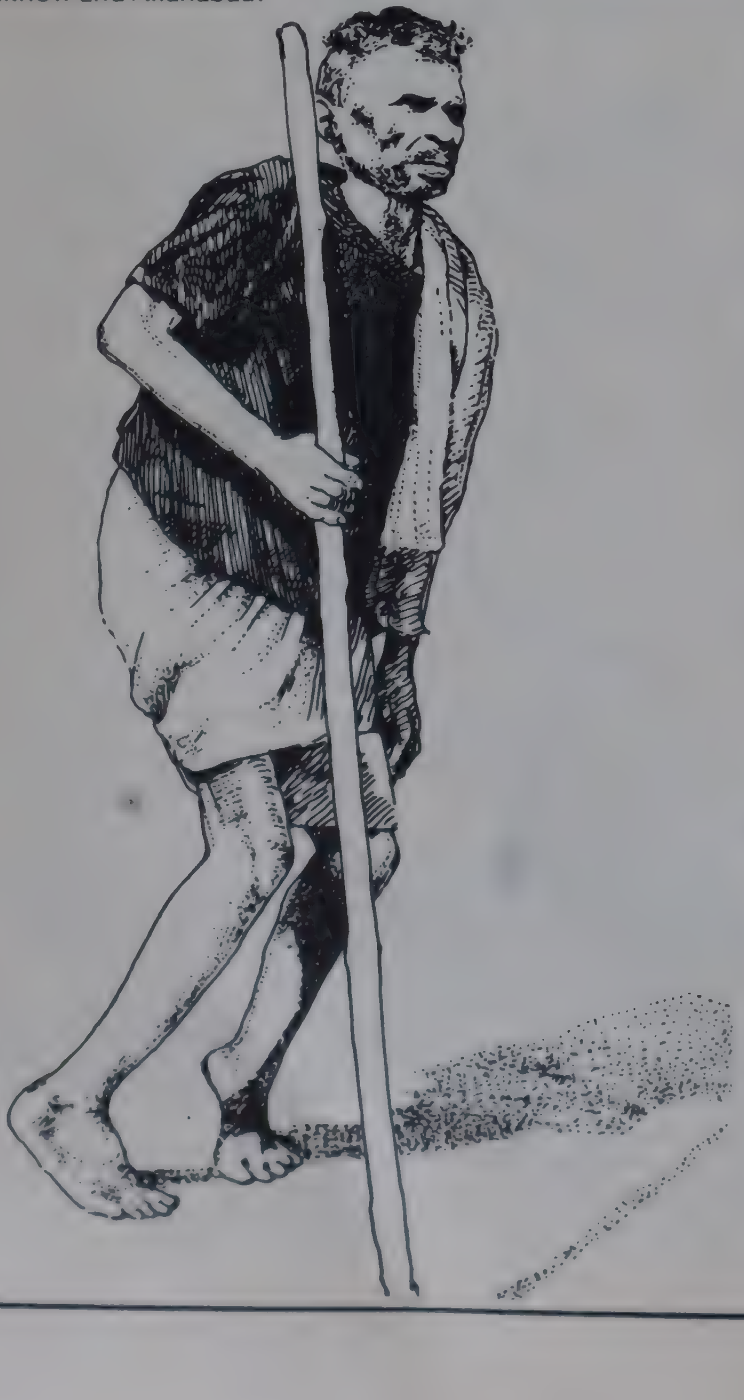
However, the government just does not want to take home-based programme seriously. A survey of 500 children in Ballabgarh found that only 13 per cent of the families had even heard of ORT and those who had learnt of it from the rare radio announcements did not know how to go about it properly. So a simple technique which could save hundreds of lives every year is going abegging just because the well-fed officialdom whose children never die of diarrhoea, doesn't care to do anything about it.

## Lathyrism: symptoms of a lame government

*Lathyrus sativus*, or khesari, is a hardy pulse, growing when all other crops fail. But it contains a toxin which causes irreversible paralysis of the legs—lathyrism—and those affected are usually the poverty-stricken bonded labourers who are forced to accept handfuls of khesari as wages from their landlords. In drought years, particularly they get little but khesari to eat and the number of maimed people rises dramatically. The Satna and Rewa districts of Madhya Pradesh abound in lathyrism cases and in 1974 there were major outbreaks in the Raipur and Chattisgarh districts as well.

But the state government has not even been prepared to admit the existence of the maimed, secure in the knowledge that the primary health centres do not record cases of lathyrism. In fact, before social worker Jyoti Prakash of Satna filed a suit in the Supreme Court alleging that the government was doing nothing about the problem, it was only prepared to admit the existence of 2,200-odd cases, as against a post-suit admission of over 40,000 cases. State governments are equally reluctant to provide real khesari acreage and production figures. In 1977-78, some 0.77 million hectares were under khesari in Madhya Pradesh alone. In recent years, the area under lathyrus has grown substantially.

With the Green Revolution in wheat swamping the area under pulses, the prices of pulses have multiplied nine to 18 times in the last 30 years or so. As a result, there is now a massive adulteration racket, with higher-priced pulses like arhar and bengal gram flour (besan) being widely mixed with the cheaper khesari. These adulterated pulses are exported even to the southern states as far as Kerala. Adulterated besan today sells openly in big towns and cities of Uttar Pradesh like Lucknow and Allahabad.



The adulteration trade is in full swing in Raipur and Chattisgarh areas of Madhya Pradesh, where it is carried out openly. Lathyrus comes to the market on ponies or on labourer's backs. The seeds are then transported by truck to Satna and from there by train to Bombay and by truck to other centres.

The government has tried to ban bonded labour and cultivation of khesari but in both cases has fallen flat on its face. In 1961, the Union Ministry of Health had announced its intention to ban the marketing of khesari. It later banned the mixing of khesari with besan under the Prevention of Food Adulteration Act but left it to states to implement the ban. This government fiat. thus, remained a paper tiger. In 1963, the Madhya Pradesh government proposed to ban the cultivation of khesari after the harvest season was over but it revoked the ban before the next harvest because of the powerful lobby of landlords. Uttar Pradesh banned the cultivation of khesari in 1982 but the law is widely flouted there. Nearly 1000 farmers of Ghazipur and Ballia planted khesari in full defiance of the law in late 1983. They even wrote to the government of their intention in advance but no police force was present to stop them. Both the opposition and the ruling party supported the farmers. Even the communist government of West Bengal has done little to ban khesari. The Planning Commission had set up a group to investigate the problem in 1982 but its report is still awaited two years later. And now with new vested interests being created through the adulteration racket, its cultivation will definitely grow even more.

Scientists have also played an extremely irresponsible role in helping the government to justify its prolonged prevarication. Every time public pressure has built up to demand strong government action like a ban on the cultivation of khesari, scientists have intervened by suggesting technical solutions, none of which have worked.

First, scientists from the National Institute of Nutrition (NIN) kept asserting that the toxin in khesari can be leached out by par-boiling or soaking in hot water. Even educational films were made on this technique. For long government officials claimed that villagers were fools for not adopting this detoxification process. Social workers, however, soon found why. Whole families are bonded in districts like Rewa and Satna and few people have time even though they wake up at 4 am. There is also a great shortage of fuel.

It was suggested that the Food Corporation of India set up a detoxification plant and supply detoxified khesari in exchange for the toxic dal but the company never entered the business. It was, in fact, lucky. When a team of social workers decided to set up a detoxification plant, it found many hurdles. Varieties of khesari differ in their toxin content. A simple test is, therefore, needed to confirm that khesari has indeed been detoxified. But there exists no such test. On further questioning, the NIN's scientists could not even claim with confidence how much toxin the detoxification process removed. Soon there were doubts about whether the detoxification process worked at all. A Bangladeshi scientist has said that it does not.

Meanwhile, another group of scientists claimed that protein-rich khesari ought to be retained and set about finding a low toxin strain. The Indian Agricultural Research Institute even claimed that it had found such a variety but afterwards the germplasm was reported lost. The institute was also not talking of a 'no toxin' variety but of a 'safe limit' variety. But what is the safe limit of the khesari toxin? To this question, however, there was no scientific answer. Some scientists even reported that succeeding generations of the new strain showed an increase in the toxin content. All that these unsuccessful breeding exercises did was to successfully breed a sense of complacency in the government.

The new concern about khesari in government and scientific circles does not impress Jyoti Prakash at all. "Its there now only because khesari has started reaching the urban people", he says, who after all eat khesari only in small quantities in food items made from besan. There is still no concern for those poor bonded labourers in villages who in times of drought are forced to eat nothing but khesari. The blind and lame approach of the government continues.

**Mud is being collected to cover mosquito-breeding potholes in an anti-malaria programme in Gujarat involving pesticide-free, environment control techniques. (MRC)**

of Pondicherry, thwarted by a suspicious and all-powerful panchayat, which convinced the villagers that the organisation was out to disrupt the social fabric. The VCRC then shifted ground. First, it helped panchayat leaders undertake general welfare measures and acted as a link between them and other government agencies to help settle local grievances. Secondly, it looked out for ways to link vector control to income generation.

The backwaters near the villages teem with mosquitoes. They are also full of algae for most of the year, which means that the fish cannot effectively sweep the waters clean of eggs. The VCRC discovered that it was possible to make a kind of mottled art paper with the algae and soon enthusiastic villagers formed a society to collect and market algae and the government may even help set up a cottage industry to manufacture paper and cardboard from the algae. Similarly, it was found that in certain small pools which are highly mosquitogenic, it was possible to culture prawns and reduce the number of mosquitoes: many such pools are now swept clean of mosquitoes and the villagers are making money.

But efforts elsewhere have generally failed to evoke much response. All along the Coromandel coast casuarina trees are grown as a cash crop and for local use as firewood. Shallow pits are dug to ensure that the trees get water until their roots reach subsoil water, and the pits form a perennial mosquito breeding source. Indigenous larvae-eating fish were introduced in these pits and controlled mosquito breeding to the extent of 96 per cent. Though the fish is present in large quantities in nearby ponds, the villagers did not take much interest in regularly seeding these pits with the fish. The VCRC could not find any edible fish that could grow in the pits.

Similarly, the earthen pots where the coconut husk rots are major sources of mosquitoes. But villagers did not want to empty these pots regularly as they would have to travel long distances to refill them. Covering the pots with a nylon netting was effective but again the villagers did not keep the pots covered all the time. VCRC's scientists conclude that community participation in vector control works best when it is tied to economic development programmes.

In late 1983, MRC took up an environmental control programme in eight villages of the malaria-infested Kheda district of Gujarat, where mosquitoes have already become resistant to DDT, BHC and malathion. The participation of villagers has been ensured by forming village health committees. Demonstrations have been held to acquaint people with the way in which mosquitoes breed and fish eat mosquito larvae.

The results were gratifying. Malaria cases were 75 per cent down in the first three months of 1984 as compared to the corresponding period of 1983, and in April, four villages did not record any cases. Encouraged by these results, the MRC now plans to extend the pilot project to 25 villages and later to a whole taluka. If indeed these experiments show that environmental control measures are more cost-effective than pesticides, mosquito control in India could take a new direction.

C.F.T.R.I.

# ENERGY

*Urban Indians purchase 14-20 million tonnes of firewood every year, worth over Rs 500 crore — more money than the government spent on afforestation in the 30 years between 1950 and 1980.*

*Delhi today gets firewood from Assam, over a thousand kilometres away*

*With firewood prices rising rapidly — doubling in many cities in the last six years — firewood is more expensive than even black market kerosene.*

*Urban poor suffer the most from high firewood prices, losing as much as 20 per cent of their meagre incomes. Middle class families spend less than 10 per cent.*

*Felling of trees for urban fuelwood consumption is a major source of forest destruction. Three-fourths of firewood used in towns and cities is in the spape of logs.*

*Even in technology-proud India, work animals are destined to stay. The country's vast electricity network just about matches its 80 million work animals in energy generation.*

*From an installed nuclear capacity of 1100 mw, India plans to reach 10,000 mw by the end of the century, at a whopping cost of Rs 14,000 crore.*

*Delays and cost overruns have plagued the nuclear programme. Rajasthan and Madras stations have cost almost twice the original estimates and completion has been over eight years late.*

*Leaking nuclear fuel rods have turned the insides of Tarapur into a radio-active purgatory. Between 1000 to 1500 "temporary workers" have to be used for maintenance every year — a kind of hit and run job.*

*No definite strategy exists for safe disposal of radioactive wastes. The Kolar mines near Bangalore are being studied as a possible repository.*

Energy is any society's fundamental need. India, as it moves into the 21st century, faces acute energy shortages. The country's planners have mainly focussed on modern fuels while they have totally neglected traditional fuels in the hope that modern fuels will one day replace traditional fuels. The result is an energy crisis on all fronts. A cooking energy famine stalks vast areas of the land today. Even the country's relatively well–endowed urban areas have not been able to move away from a traditional cooking fuel like firewood — a fact little known and never taken into account in energy planning. Meanwhile, hungry animals continue to transport goods across the country. At the same time, modern industry and transport systems, which have developed around modern fuels, have also come to face energy shortfalls.

Energy generation programmes are now being given a high priority by the government. However, the key need today is to go beyond assessments of cost–effectiveness and comparative cost advantages of different energy strategies. There are environmental costs associated with almost every modern energy device, particularly modern electricity generating devices. In a poor country, in which environment is often the sole source of sustenance, energy generation cannot be allowed to become an excuse for environmental destruction and human impoverishment. If thermal power stations are a major cause of land destruction by mining and heavy atmospheric pollution, hydroelectric power stations have become a major cause of forest destruction, adverse changes in riverine ecology and massive displacement of human communities. The environmental costs of nuclear power stations are not even fully understood.

If India and its people must benefit in a rational and healthy manner from energy growth, then the environmental and social costs of India's energy development must be carefully assessed, comparative ecological and social advantages of different energy strategies clearly identified — even more carefully than comparative economic advantages — and the country's ultimate energy strategy determined accordingly. Misguided notions, influenced by the–abiding Western bias must be eschewed. Today there is a famine of traditional fuels. But tomorrow they can become a major driving source for India's growth and human wellbeing. Only a lack of imagination and political will can act as an obstacle

# COOKING ENERGY

## Firewood in the cities

Firewood is one of the most important fuels for India's poor and the firewood trade in India's town and cities employs millions of people. Yet energy experts and planners, while acknowledging the importance of firewood in the villages, underestimate its prominence in the cities. The few studies on urban energy consumption clearly reveal the growing dependence, especially of the urban poor, on firewood for fuel.

If the per capita consumption figures of firewood in urban areas used by the Planning Commission's Working Group on Energy Policy are accepted, India's urban population spent Rs 900 to Rs 1,000 crore during 1981 on 22 million tonnes of firewood at an average price of Rs 400 per tonne and collected another 7 million to 8 million tonnes of wood from trees, worth some Rs 300 crore in the market. On the other hand an unpublished National Council for Applied Economic Research (NCAER) study, reporting 1978-79 data, estimates urban firewood consumption to be only about 16 million tonnes, of which 14 million tonnes are purchased, indicating an annual urban firewood market of Rs 500 to Rs 600 crore.

Firewood prices have risen rapidly. In many cities they have doubled in the last six years. In Delhi, firewood sells for 65 paise per kg in the summer and touches 80 paise in the winter, making the capital among the costliest cities in the world for firewood. In Bangalore, firewood sells for 45 paise per kg, in Uttar Pradesh hill towns for about 40 paise per kg and in the firewood exporting state of Madhya Pradesh, at about 30 paise per kg.

### Firewood in Delhi

Delhi has a voracious appetite for the fuel. In other cities substantial amounts of firewood arrive by truck, bullock carts and as headloads, in Delhi it comes mainly by rail.

At the Tughlaqabad railway station 12,423 wagons of firewood each—carrying an average of 18 tonnes — were offloaded for sale during 1981-82, that is 34 wagons a day. Most of this wood came from forests in Madhya Pradesh situated nearly 700 km away. These 223,600 tonnes of wood sold at a total retail price of Rs 14 to 18 crore to households, roadside restaurants (dhabas), bakeries, crematoria and cottage and small industries. The Shahdara railway siding also gets two or three wagonloads of firewood daily from forests in the Himalayan foothills, Assam and Bihar.

In addition, the forested areas and trees within Delhi yield thousands of tonnes annually. Green areas are important sources of fuel for poor people like gardeners, peons and watchmen who collect 8 to 10 kg of dry twigs and branches at least twice a week for their personal use. Every evening thousands of cyclists can be seen in the suburbs carrying home a bundle of firewood. A few people also collect firewood for sale from forested areas like the ridge, near the Delhi university campus. A person interviewed there said he spent three to four hours a day collecting 10 to 12 kg of wood which he sold for Rs 3 to Rs 5. Another wood-based energy source is sawdust and thousands of tonnes generated by Delhi's furniture and wood-based industries are sold to households situated around sawmills.

Delhi's per capita firewood consumption is much lower than the national average for urban areas as calculated by the Planning Commission. According to these figures, Delhi's total firewood consumption in 1981 should have been 1.2 million tonnes, worth Rs 76 crore. Three-fourths would have been purchased and the rest collected from the immediate environment. Delhi's total firewood consumption is probably about 200,000 tonnes.

The reason for this is the excellent supply of kerosene, coal and LPG (liquid petroleum gas). Delhi has the highest per capita consumption of kerosene. The percentage of households using soft coke is next only to Bihar and West Bengal. The average LPG consumption in Delhi, according to Indian Oil officials, is 15,000 cylinders a day. While the waiting period for refill cylinders in the towns around Delhi has sometimes been as much as 90 days, Delhi has top priority in LPG supply.

### The Tughlaqabad phenomenon

What is most amazing is that the quantity of firewood offloaded at the Tughlaqabad railway siding is rising more rapidly than the population of Delhi. In the decade between 1971 and 1981 Delhi's population increased by about 50 per cent, while the number of wagons offloading firewood increased by about 200 percent: from 4, 121 in 1972-73 to 12,423 in 1981-82.

One reason for this could be that the poor can no longer afford kerosene and coal. There are several lakh people in Delhi without ration cards who prefer firewood because the open market kerosene and coal is out of their reach. Even ration card holders turn to firewood when they are offered poor quality coal at rationing shops.

A second explanation could be that earlier firewood from Uttar Pradesh and Himalayan forests arrived at other railway sidings in the city such as Shahdara. With these sources drying up and the Uttar Pradesh government's restrictions on tree-felling, Delhi's firewood supply has shifted to other areas like Madhya Pradesh and Orissa which are connected to the Tughlaqabad siding.

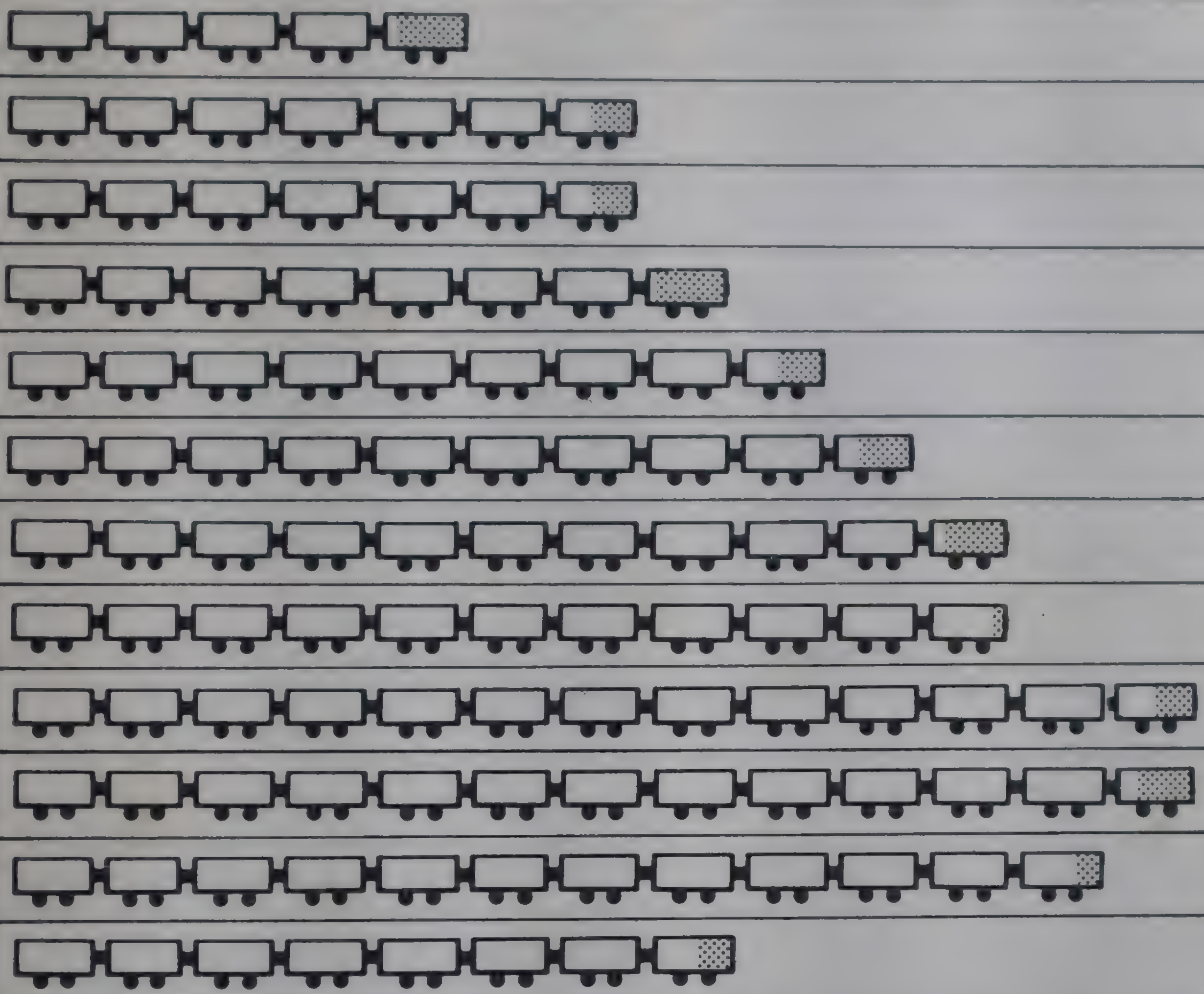
A third factor appears to be the most significant: massive beforestation around Delhi. Earlier, many people could easily collect firewood from the vegetation in and around Delhi. Large areas along the banks of the Yamuna river, for instance, including the entire area that is now Shahdara, were once rich green regions. Firewood sellers would sell headloads of wood directly to richer households. There were few mediating wood traders as households made regular supply arrangements with the vendors.

Today, with the devastated vegetation, people are being forced to depend on firewood from outside Delhi. Elderly firewood stall-owners claim that 20 to 25 years ago there were far fewer firewood stalls in the city than the present number of at least a thousand. The Tughlaqabad phenomenon indicates the rapidly increasing commercialisation of firewood.

### Traditional energy sources

There are still thousands of people in Delhi who use other traditional fuels such as cowdung cakes and do not depend on firewood. But slight changes in their environment or in their lifestyles—loss of land, change in

**Firewood delivered at Tughlakabad railway siding since 1972**



| Year | No. of wagons | % of total wagons |
|---|---|---|
| 1972-73 | 4,121 | 18 |
| 1973-74 | 6,422 | 21 |
| 1974-75 | 6,435 | 14 |
| 1975-76 | 7,080 | 11 |
| 1976-77 | 8,410 | 13 |
| 1977-78 | 9,391 | 19 |
| 1978-79 | 10,124 | 16 |
| 1979-80 | 10,926 | 14 |
| 1980-81 | 12,370 | 13 |
| 1981-82 | 12,423 | 13 |
| 1982-83 | 11,751 | 12 |
| 1983-84 | 7,577 | — |

Each wagon carries an average of 18 tonnes of firewood. Source: Head goods clerk at Tuglakabad siding.

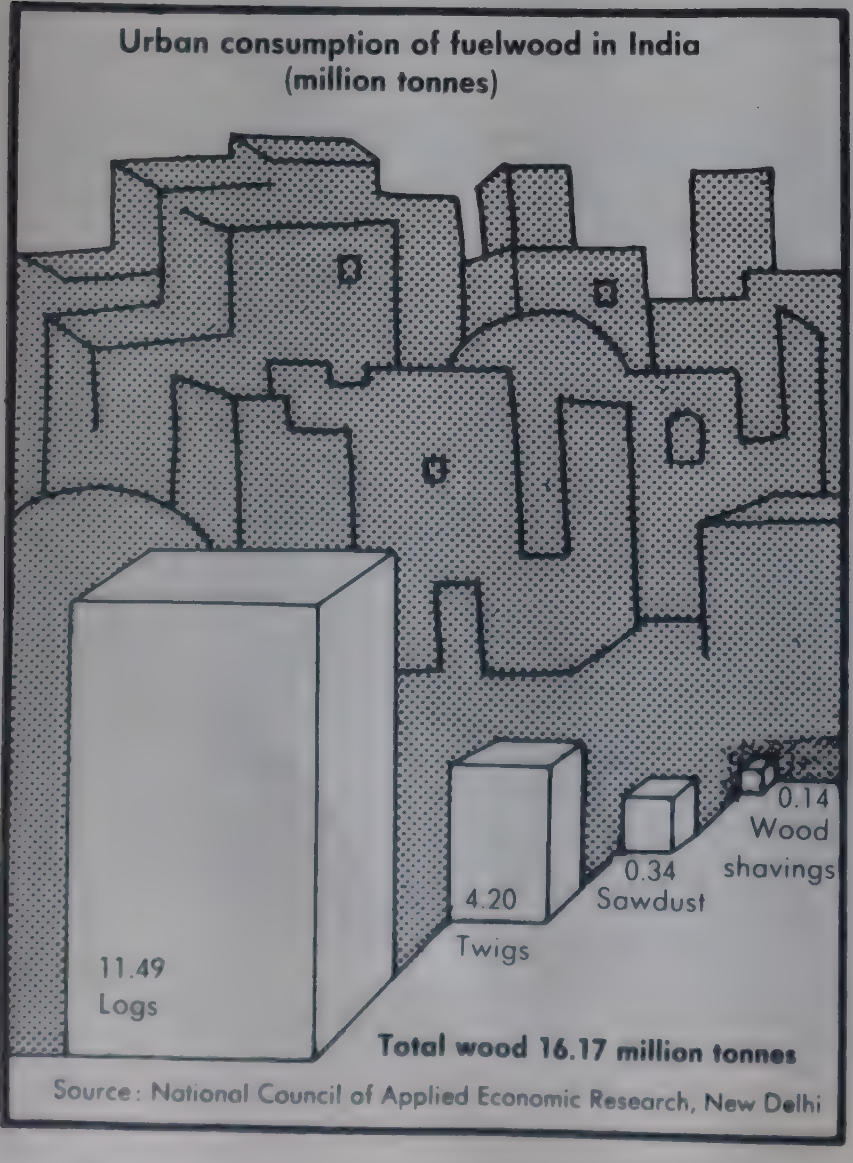
Every tenth railway wagon into Bangalore comes loaded with firewood. The city consumes nearly half a million tonnes a year. (Bhawan Singh/ India Today) occupation or further destruction of vegetation—could easily turn them into collectors or purchasers of firewood.

Take the squatter settlement opposite Kamal Cinema, situated in Delhi's upper middle class Safdarjung Enclave area. The squatters collect all they need—cowdung cakes, weeds and wood bark—from around the settlement. About half the households own buffaloes and most earn between Rs 250 and Rs 750 a month by selling milk. Some 15 years ago, these people would collect firewood from the surrounding green areas. Now all these areas have disappeared with the construction of houses. Today they use kerosene for lighting and burn old tyres in winter for warmth.

Even totally unrelated changes can have a profound impact on the consumption pattern of such people living on the verge of survival. Several people in settlements near railway lines, such as those in Shahdara and in Annanagar near the Income Tax Office, said they collected the coal thrown out by steam engines for domestic use. With the arrival of diesel and electric engines, they are now forced to purchase and collect firewood, cowdung, and waste plant materials.

There is money, lots of it, in the firewood trade. Sales of firewood from Madhya Pradesh forests are totally controlled by the state's forest department. The department auctions stacks of 2 cum (anywhere between 800 kg and 1,200 kg or about a tonne of firewood) and these are usually purchased at Rs 30 to Rs 50 per stack by large timber contractors. On one occasion, the bid even reached Rs 108 per stack. The cost of producing a stack of firewood is generally about Rs 4 in the plains and Rs 5 in the hills.

Urban consumption of fuelwood in India (million tonnes)



Source: National Council of Applied Economic Research, New Delhi

Since 1981 export of firewood from Madhya Pradesh has been banned. Purchasers are given transit passes, which entitle them to carry firewood across the border. By the time this firewood reaches a railway loading site in Madhya Pradesh, its price is about Rs 40 to Rs 80 per tonne. The railways then charge about Rs 100 per tonne to transport the wood from a place like Balaghat in Madhya Pradesh to Delhi. The price of firewood by the time it arrives at Tughlaqabad is about Rs 150 per tonne. From there the wood is sold to intermediary wholesalers who then pass it on to retail firewood depots. By the time it reaches the poor consumer, the price escalates to Rs 650 per tonne—1,600 to 2,000 per cent over the price at which it was sold by the forest department.

Out of the Rs 12 to Rs 15 crore firewood sales in Delhi every year, about Rs 0.50 to Rs one crore goes to the forest department as profit and at least about Rs 8 to Rs 10 crore as income to contractors and retailers. In effect, 75 to 85 per cent of the money that a poor consumer pays for firewood ends up as profits for the government and the middlemen.

### Costlier than kerosene

At their current prices, kerosene is more expensive than firewood when their energy contents are compared. In other words, kerosene gives less energy than firewood for every rupee spent. But if the same amount of food is to be cooked, then using a kerosene stove is much cheaper. The efficiency of a firewood chulha is seldom over 5 to 7 per cent. Kerosene stoves have an efficiency of 40 per cent. Kerosene is, thus, 80 per cent cheaper to use than firewood if investment in a kerosene stove is possible. This would be true even if kerosene had to be purchased at Rs 4 a litre in the open market.

Why then do people purchase firewood instead of kerosene? The reasons are not obvious. In metropolitan cities like Delhi, firewood purchasers are mainly low income households, earning well below Rs 500 per month such as construction workers. They have little time to collect firewood or cowdung. They also lack adequate housing and cannot keep a kerosene stove and risk having it stolen. None of their belongings is usually worth more than Rs 10. A switch to kerosene from firewood for such people would only be possible if they had a proper house to ensure the safety of their stove and also be assured that kerosene was readily available. In other words, firewood consumption in cities is related to the problem of slums. If more people come to live in slums and on pavements, greater will be the consumption of firewood.

A poor family, earning less than Rs 500 per month and heavily dependent on firewood, can be forced to spend up to 20 per cent of its income on energy needs, while a middle class family earning more than Rs 1,000 will rarely pay more than 10 to 15 per cent. The general rule appears to be that the urban poor spend a higher proportion of their income on energy than the rich.

Interviews with firewood stall owners reveal that apart from individuals purchasing firewood for domestic use, firewood is also consumed by roadside tea stalls, restaurants, bakeries, small scale dyeing units, soap makers, various cottage industries and for cremations.

There are about 40,000 deaths in Delhi every year. There are five municipal and about 125 private crematoriums using

## The Urban Cowdung Network

Fancy new gas stoves and cookers notwithstanding, cowdung is still one of the staple fuels in Indian towns and villages. Planning Commission data show that 5 million tonnes of cowdung—32 kg per person per year—are burnt every year in urban India. Most studies put the total rural and urban cowdung consumption at 70 to 75 million tonnes of dry dung. A reasonable proportion of the cities' supply comes from cattle in the cities themselves, but the villages deliver a considerable amount to make up the shortfall.

Everyday, at least 200 donkeys, and 25 bullock carts as well as some small sized trucks can be seen ferrying cowdung cakes to Agra, sometimes from as far as 20 km away. In addition at least 1,000 women in Agra make a living out of collecting cowdung and selling cakes. It is mostly the Agra poor who use this fuel, other sections use it to ignite coal fires, at home and in potteries and small factory furnaces.

The total cattle population of urban Agra (Agra city and various towns in the district), about 30,000, should yield about 70 tonnes of dry cowdung daily, assuming 12 kg of wet dung per animal per day and that all of it is collected. Urban Agra consumes 120 tonnes of dung every day. The 6 lakh cattle in rural Agra produce about 1440 tonnes of dry dung daily. Almost all the dung collected in rural areas is used in the villages, the small remainder going to the towns. Interviews with villagers in rural Agra reveal that very little cowdung is left for manuring, which must affect soil fertility.

The division of labour is simple: women collect dung and make cakes, men handle the trade. The salesmen bring dung cakes to a commission agent's shop on the outskirts of Agra city. The agent takes about Re one for one donkeyload—75 to 100 kg—and the dung salesman delivers the supply to the buyer. Some firewood stall owners purchase cakes directly from village salesmen and sell them for about 40 paise per kg. Many villages near Agra city which are becoming urbanised also purchase dung cakes in substantial quantities.

The trade is not lucrative. A donkeyload sells for about Rs 25. After substracting the agent's commission and the price paid for purchasing this dung in the village the dung salesman earns about Rs 4 to Rs 5 per trip. If a villager makes a trip every alternate day, he is able to earn a measly Rs 60 per month. But even this is a useful supplementary income, especially when agricultural labour is not required. Women in the city make between Rs 80 and Rs 120 a month by collecting and selling dung.

In villages, a few families purchase dung cakes from dung-surplus families. For instance, in Dehtura village of Bichpuri block of Agra district, dung is the main fuel and, almost one-fifth of the families purchase dung cakes at rates almost equal to that in cities. Apart from donkey owners who buy dung to sell in towns, many potters also come to Dehtura to purchase dung.

The Delhi poor, especially those in villages and settlements on the outskirts, consume a reasonable amount of dung. Delhi households are estimated to consume about 16 tonnes of cowdung a day, working from a per capita consumption of one kg a year. But as hundreds of potters around Delhi also use an enormous amount of cowdung in their kilns, the use of cowdung as fuel will be much larger. Some small-scale factories also purchase dung to fire their furnaces.

The per capita consumption of fuel in Delhi's villages, on the other hand, is much higher, 121 kg, or about 147 tonnes daily for all villages. As Delhi's cattle should yield about 500 tonnes daily, there is clearly a surplus of cowdung in the union territory. This probably accounts for the lower prices of dung cakes, about 20 to 25 paise per kg in Delhi compared to 40 paise in Agra.

A substantial amount of dung is collected within the city itself. In Sarai Kale Khan, for instance, an old village now engulfed by the colony of Nizamuddin, there are many small dairies. Women from the households of the dairyowners collect the surplus dung, dry it near the railway track or on the roof and walls of their houses, and sell the dung cakes directly to consumers or to middlemen.

Some dung also comes into the city from neighbouring villages. Masudpur, in Mehrauli block is a well known village for surplus dung. Most of the dairies in south Delhi were shifted to this village during the emergency period to clean up the city. A number of enterprising women mainly wives and daughters of animal owners and many landless and Harijan women handle the dung business in Masudpur. Several women also come to Masudpur from other villages within a radius of 8 km to 10 km to earn money from the business. Women usually work on a fifty-fifty basis with dairy owners: they collect and dry the dung cakes daily and take home every alternate day's production.

On an average day, a woman is able to make cakes from the dung of eight to 10 animals, 20 to 25 kg, which fetches about Rs 4. Some cakes are retained for personal use, and their monthly income is usually a little under Rs 60. One dairy owner's wife claims that she earns up to Rs 200 per month from dung cakes since she employs the women and children in her family as labour.

Many donkey and mule owners come to Masudpur to purchase dung cakes which they sell in the city and nearby villages. One enterprising person in Masudpur supplies dung cakes to factories in the city by truck, at Rs 300 per truckload of about a tonne. He buys in bulk from Masudpur at around Rs 125—at a higher price in the monsoon—and pays Rs 100 for hiring a truck. He makes Rs 75 per trip and arranges four or five trips in a month. For some even something as mundane as cowdung can be good business.

**Donkeys bring dung cakes to Agra every day. Urban India burns 5 million tonnes of cowdung annually. (Rob Mackay)**

**Comparative costs of fuels in Delhi**

| Energy source | Unit | Unit price | Calorific content of Unit (GJ) | Cost of primary energy (Rs/GJ) | Efficiency of cooking device | Useful energy when one unit of fuel is used (GJ) | Cost of useful energy (Rs/GJ) |
|---|---|---|---|---|---|---|---|
| Firewood | 1 kg. | Rs 0.65 | 0.0167 | 38.92 | 7% | 0.0012 | 541.67 |
| Kerosene(controlled price) | 1 litre | Rs 1.90 | 0.0446 | 42.60 | 40% | 0.01781 | 106.74 |
| Kerosene (open market price) | 1 litre | Rs 4 | 0.0446 | 89.69 | 40% | 0.01781 | 224.72 |

Note: (1) Calorific contents of firewood and kerosene taken from "Energy in a Stratified Society — A case study of firewood in Bangalore," A.K.N. Reddy and B. Sudhakar Reddy, Indian Institute of Science.
(2) GJ: Gigajoules

wood. There are also a few electric crematoriums in the city but these are not favoured by the Hindus. Normally, about 300 kg of wood are needed to cremate a body. The municipal crematoriums supply wood on a no profit-no loss basis to their clients at about 50 paise per kg which they purchase directly from Tughlaqabad. Even if it is assumed that half the deaths are in non-cremating communities, of Hindu infants who are not cremated and of Hindus who are sent to electric crematoriums, some 20,000 corpses are still burnt in Delhi every year. This means that 6,000 tonnes of firewood valued at between Rs 30 and Rs 40 lakh are consumed in Delhi every year in pyres.

Poor people often cannot afford to cremate their dead as the entire process costs as much as Rs 300, including the price of wood. They often leave half-burnt bodies in the river Yamuna or sometimes dump unburnt corpses into the river after sprinkling "holy water" from the river on them.

### Bangalore consumes more

A recent study by scientists at the Indian Institute of Science in Bangalore shows that Bangalore is an even bigger consumer of firewood than Delhi. Its consumption figures compare well with the higher estimates of the Planning Commission on per capita fuelwood consumption—about 440,000 tonnes of commercial firewood a year. In Bangalore 85 per cent of this comes from private farms and forests, 30 to 150 km away from the city, and another 15 per cent from government forests, 300 to 700 km away in Uttar Kanara and Goa.

Firewood from private farms and forests is transported into the city by road by on an average 114 trucks per day. Firewood from government forests comes by rail and the rest on bullock carts or as headloads from around the city. Domestic cooking and heating water accounts for about four-fifths of the total consumption of firewood. But over four-fifths of the city's domestic firewood consumption is by households with a per capita income of less than Rs 200 a month, constituting 32 per cent of the households in the city. Firewood in Bangalore, too, is used mostly by the poor, who spend an estimated 17 per cent of their income on it.

The study estimates that as much as one-fifth of the truck traffic into Bangalore and one-tenth of the railway wagon traffic is tied up with firewood transport. As firewood is finally burnt in a chulha with an efficiency of 5 per cent, it takes 26 units of energy in the form of imported diesel to transport the firewood which ultimately delivers 100 units of useful energy.

Hyderabad is another major consumer of firewood. A 1981 study put the city's consumption at about 150,000 tonnes. The wood comes from various districts in Andhra Pradesh itself but as these districts are not connected by railway lines, 95 per cent of the wood comes on trucks and the rest comes on bullock carts. The farthest area from which wood comes is Bhadrachalam, about 280 km to the east, and Adilabad to the North.

Only 10 per cent of the firewood is supplied by the forest department. Private wood suppliers are the main source and it reaches the consumers through a series of intermediaries. Some 15 commission agents operate in the city and they work at six wholesale centres. There are 472 retail outlets in metropolitan Hyderabad or one per 4,450 persons, and as many as 97 per cent of these outlets are in north and south Hyderabad, the poorer parts of the city. The trade appears to be booming: some 48 per cent of these retail outlets began less than five years ago.

The price at wholesale centres ranges from 8 paise to 25 paise a kg; at the retail centres it ranges from 33 paise to 37

**Firewood stalls are common in urban India. Annual urban firewood sales are over Rs 500 crore. (C. Stauffer/FAO)**

paise a kg. The wholesale centre at Ghatrinaka sells the cheapest wood at 8 paise a kg, but it mainly handles poor quality wood made up of twigs and chipped bundles, which the poorest buy.

The study found that low income families (up to Rs 500 a month) spend 11 per cent of their income on cooking fuel whereas higher income groups (3,000 a month and above) spend only 2 per cent.

A check on firewood prices in 1983 revealed that the average wholesale price had jumped by 94 per cent from Rs 245 a tonne in 1981 to Rs 475 a tonne in 1983; and the retail price had gone up by 67 per cent from Rs 345 to Rs 575.

### Smaller towns suffer

The situation in smaller towns is even worse. Kerosene and coal supplies are highly erratic and inadequate and LPG supplies almost non-existent. Even the richer sections use firewood. In mid-September 1983, the 'Hindustan Times', a national daily, reported that LPG shortages in several Uttar Pradesh towns led to riots. In towns like Ghaziabad, Meerut, and Roorkee, for instance, people had to wait for more than 90 days for refill gas cylinders.

The inadequate supply of kerosene has forced many in Rajasthan towns to turn to firewood. Wood and charcoal supplies from the few firewood depots run by the state's forest department fall far short of demand. Hence, despite a ban on cutting green trees, villagers cut them to sell in towns as firewood at high prices. An adult Khejari (*Prosopis cineraria*) weighing 3.5 to 5 tonnes can easily fetch up to Rs 2,000 in the towns. According to environmentalist Indra Kumar Sharma from Jodhpur, villagers can easily get around the ban on cutting green trees: they make a deep cut around the trunk near the base and the tree withers within a few months.

A report in The Hindu, a leading daily from the south, revealed that thousands of people carry firewood to sell in the towns of Andhra Pradesh. To earn a desperate day's wages, villagers living within a 50 km radius of Kurnool in Andhra Pradesh periodically smuggle firewood illegally cut from forests into the town through the shuttle trains that run daily between these places. Locally, these passenger trains are known as "firewood specials" (See SOE 82).

### HOLI RESOLUTION

"The festival of Holi comes every year. Lakhs of Holi fires are lit across the country and lakhs of tonnes of wood are burnt. Observing traditions and religious rites is not bad. But if these traditions and religious rites begin to harm us, shouldn't we move with the times and break these traditions?

"Today when wood is not easily available even to cremate corpses, should we waste wood by burning it on every crossroad? What kind of religion is this? On one hand there are crores of households which do not have enough wood to fuel their hearths, on the other we are prepared to waste so much wood in the name of religion. But why?

"This year many Holi fires have already been lit. But will the intelligent citizens of Indore take a vow on this Holi that in the future they will not burn Holi fires in many places, that they will burn the Holi fire only in one place in the city and observe the festival with love and simplicity? That will also help us to understand the real meaning of this festival.

"We should save wood for those who do not have enough for their hearths. Can we not think in this direction? What we have done, we have done. But in the future we should not do anything that will not leave enough wood even for cremation."

—Editorial comment in Aaj ki Janta, a small weekly newspaper of Indore, on April 4, 1983.

The fuelwood supply situation in Uttar Pradesh town is very tight. A study conducted by the Pre-Investment Survey of Forest Resources shows that Meerut city, with a population of 460,000 consumes 54,710 tonnes of firewood—about one-third of total household energy consumption. The recorded supplies of fuelwood remain far short of demand and the study concludes that "there is a shortage of fuelwood in general". But as the supplies of kerosene and coal/coke are also short of demand, there is a general shortage of all fuels and, therefore, even those who can purchase commercial fuels end up looking for wood. There is hardly any area in or around the city with extensive vegetation. Wood is imported into the city from other areas of the state or neighbouring states.

In late 1982, during a cold wave, riots were reported in Uttar Pradesh towns following firewood shortage and spiralling prices, which reached Rs one per kg. The forest department then announced that it was planning to open wood depots in Uttar Pradesh. Forest officials complained that fuelwood supply had become tight following the enforcement of the Rural and Hill Areas Trees Preservation Act of 1976, which restricts felling of trees on private land without prior permission. To increase the availability of wood in the market, 27 varieties of trees meant for fuel and fodder have been freed from the provisions of the act. However, the ban on the felling of 11 other varieties continues.

### The nationwide impact

What impact does this firewood trade have on the natural resources of the country? Take the Delhi consumption alone. The Pre-Investment Survey of Forest Resources in 1965 has shown that forests in Central India have a "growing stock"—the basic indicator of the quantity of wood available in the forests—of 82 tonnes per hectare. This would mean that the 223,600 tonnes of firewood that come to Tughlaqabad every year can be obtained by completely denuding 2,700 hectares of good forests every year, or over seven hectares every day. As compared to this, the Madhya Pradesh government planted only 300 hectares of firewood between 1951 and 1973.

Clearfelling is a bad practice and only the "annual increment" of wood ought to be felled to sustain the forest. There are no reliable estimates of the rate of "annual increment" of wood in India and it has been variously estimated at 6.4 to 30 million tonnes, which works out to less than one tonne per hectare per year. Even if we accept the annual increment of wood at about one tonne per hectare, we would need at least 223,600 hectares of natural forests to meet Delhi's firewood needs on a sustainable basis. This even when Delhi is well endowed with supplies of kerosene, LPG and coal when compared to most Indian towns.

If energy farms were set up around the city on poor soils and with no irrigation, yielding 2 to 3 tonnes of wood every year per hectare, some 75,000 hectares would be required to meet Delhi's needs. But even if these energy plantations were set up in good soil with heavy inputs of fertiliser and irrigation yielding 20 to 30 tonnes per hectare per year, Delhi's firewood needs can only be met by some 6,000 to 10,000 hectares, unless energy-efficient devices are also disseminated to reduce firewood demand.

The urban consumption of firewood is particularly harmful to the country's environment. The recent NCAER countrywide survey of household fuel consumption reports that nearly three-fourths of the firewood used in the rural areas is in the form of twigs, whereas in the urban areas nearly three-fourths is in the form of logs. The per capita consumption of twigs is uniformly high in the rural areas of all the states. The NCAER study also shows that whereas the per capita consumption of twigs in rural areas drops only slightly with increasing income, the consumption of logs increases nearly three times with rising income.

The greater use of logs in towns and cities has major environmental implications. As twigs, and to a lesser extent branches, can be obtained without cutting down trees, whereas the use of logs necessarily requires tree-felling, it is argued that gathered firewood does not contribute to deforestation. This finding casts serious doubts on the widespread belief held by many environmentalists that the firewood demand of the rural poor is leading to extensive deforestation. They mainly lop off small branches, twigs, roots and deadwood, a practice that does not lead to deforestation, whereas use of logs necessarily implies tree-felling. But the biggest cause of deforestation remains the insatiable industrial demand for wood.

By dividing the use of fuelwood into logs and twigs, the NCAER data is able to resolve the intriguing problem first pointed out by the Fuel Policy Committee (FPC) of the Planning Commission in its report in 1974, that out of 100 million tonnes of fuelwood estimated to be consumed in the country, recorded fellings did not account for even a tenth of the estimated consumption.

The NCEAR study now shows that out of 95 million tonnes of fuelwood consumed in 1978-79, only 31.6 million tonnes were logs. Of these 19.7 million tonnes were purchased, which is close to the recorded fellings supervised by forest departments. The balance 11.9 million tonnes were obviously collected. Not all the logs came from public lands like forests because logs are collected both from public lands—illegal fellings—and from private lands. About 5.4 million tonnes of logs come from private farms, and only 5.7 million tonnes of logs from public lands. This completely destroys the myth about large scale illegal felling and destruction of forests for firewood.

However, nearly 34 million tonnes of twigs are collected from public lands—forests and roadside trees—and 20 million tonnes from private lands. It could be argued that if the energy gathering families of India were indulging in deforestation, considering that most of the energy consumed in the rural areas is gathered, all trees should have disappeared by now.

Actually, even Indian foresters do not know how much fuelwood trees yield. The Planning Commission's Working Group on Energy Policy points out that all estimates of the country's growing stock only refer to timber: wood under bark and not the wood under branches. "As fuel needs could be met conveniently from branchwood and bark, the growing stock for purposes of assessing the fuelwood resources would be higher than the figures (available in the country)," noted the working group.

## Firewood trade's impact on MP

Madhya Pradesh is today the biggest supplier of firewood to Indian cities. Its forests meet the needs of the state's own population and of an equal number of people in other states, especially in the towns and cities of north, central and western India.

At the Balaghat and Jabalpur railway sidings, dozens of wagons can be seen loaded with firewood destined for places like Mahim and Dadar in Bombay, Laxmibai Nagar near Nagpur, Tughlaqabad in Delhi and Allahabad in Uttar Pradesh. Nearly 1,800 wagons of firewood were despatched in 1981 from Jabalpur alone.

### Government earns from forests

The working of forests and sale of forest produce was nationalised by Madhya Pradesh in phases through the mid-70s. Sales of forest produce now provide a substantial income for the state government. In 1980-81 about one-sixth (16.3 per cent) of the state's revenue came from forests, or over half (52.8 per cent) of all the revenue obtained by the state from non-tax sources. In the 10 years between 1969-70 and 1980-81, the state's total revenue from forests jumped nearly five fold from Rs 30.96 crore in 1969-70 to Rs 153.21 crore in 1980-81. The revenue from timber and firewood increased at an even faster rate, recording a 21 fold jump during the '70s. In 1980-81, Rs 93.42 crore came from sales of timber and firewood alone. By contrast, bamboo, most of which goes to paper mills at highly concessional rates, fetched the government a paltry Rs 7.16 crore in that year.

The total employment in the forestry sector is estimated at 71 million person-days, inclusive of 27,000 people employed full-time and those who work piecemeal.

According to official statistics, firewood production has gradually overtaken timber production. The percentage of fuelwood production in total wood production increased from 52.56 per cent in 1970-71 to 70.30 per cent in 1980-81. While the production of timber remained almost stagnant: 1.5 million cum in 1970-71 and 1.69 million cum in 1980-81 that of firewood accelerated almost two-and-a-half times: 1.66 million cum and 4.0 million cum in corresponding years. But as revenue from timber and firewood has increased at a much faster rate than increase in production, it is evident that scarcity and, correspondingly, prices of timber and fuelwood have rocketed upwards.

### Forest sources depleting

Official Madhya Pradesh statistics claim that as much as one-third of the state's geographical area is under forests. But this statistic only means that over one-third of the state's land area is under the state forest department's control. There is no guarantee that even half of this land has good tree cover. A state government document states: "The truth is that . . . instead of growing, the forest resources are depleting."

Further destruction of Madhya Pradesh's forests will mean further destruction of India's forests. The state possesses not only one-fifth of India's forest area but probably a larger proportion of the country's still heavily

**Prices of firewood in selected towns (Rs/quintal)**

| Town | Year 1960 (A) | Year 1975 (B) | Year 1983 (C) | Relative Increase (C/A) |
|---|---|---|---|---|
| Kanpur | 6.1 | 21.0 | 52.3 | 8.50 |
| Ahmedabad | 9.0 | 28.3 | 55.5 | 6.17 |
| Indore | 5.7 | 24.3 | 60.0 | 10.52 |
| Bombay | 8.5 | 36.1 | 85.7 | 10.12 |
| Bangalore | 4.7 | 21.0 | 50.0 | 10.68 |
| Hyderabad | 6.6 | 23.2 | 55.0 | 8.33 |
| Madras | 8.2 | 25.4 | 59.1 | 7.16 |
| Delhi | 10.1 | — | 85.0 | 8.46 |
| Calcutta | 9.3 | — | 61.3 | 6.61 |

Source: Labour Bureau, Simla

forested areas. The officially stated forests have been denuded by official sanction and patronage to meet the timber and firewood needs of urban areas and the pulp needs of the paper industry. A spokesperson of a paper mill recently pointed out that the northeastern states and the Bastar region of Madhya Pradesh are the only remaining major sources of bamboo in the country.

The continuing denudation of Madhya Pradesh forests will have major implications for the ecology of northern and central India as the watersheds of several major rivers lie in the state: over a quarter of the 30 million hectares comprising the total upper catchment of the Ganga-Yamuna river system, the entire upper catchment area of the Godavari and Mahanadi rivers. Less than 4 per cent of the critical areas have been subjected to soil conservation treatment. Even if an attempt was made to treat all these critical areas in the next 20 years, 150,000 hectares will have to be treated every year, more than the total area treated uptil now.

Railway lines are adversely affecting the state's forests just as the border roads, constructed after the Indo-Chinese war, affected the Himalayan forests. A map prepared by the state government showing levels of firewood scarcity in different areas of the state reveals that mostly those areas not touched by the rail network are satisfactory or surplus in local fuelwood requirements. The railway lines almost appear to suck out the firewood and timber from the neighbouring forests. The firewood surplus or satisfactory areas are Bastar, Panna, Chhatarpur, Sarguja and Mandla.

## Growing deficit

A systematic survey conducted by the state's forest department towards the end of the '70s showed that out of the state's 45 districts, as many as 26 were already deficit in firewood to meet local needs. Unless concerted efforts were made almost all districts would be fuelwood-deficient by the year 2000.

The Madhya Pradesh forest department is partly to blame for the current situation. Afforestation has lagged far behind the rate of denudation: in the last 25 years only 0.3 million hectares have been afforested. Of this a third were planted only in the last two years.

Gross revenue from forests has always exceeded

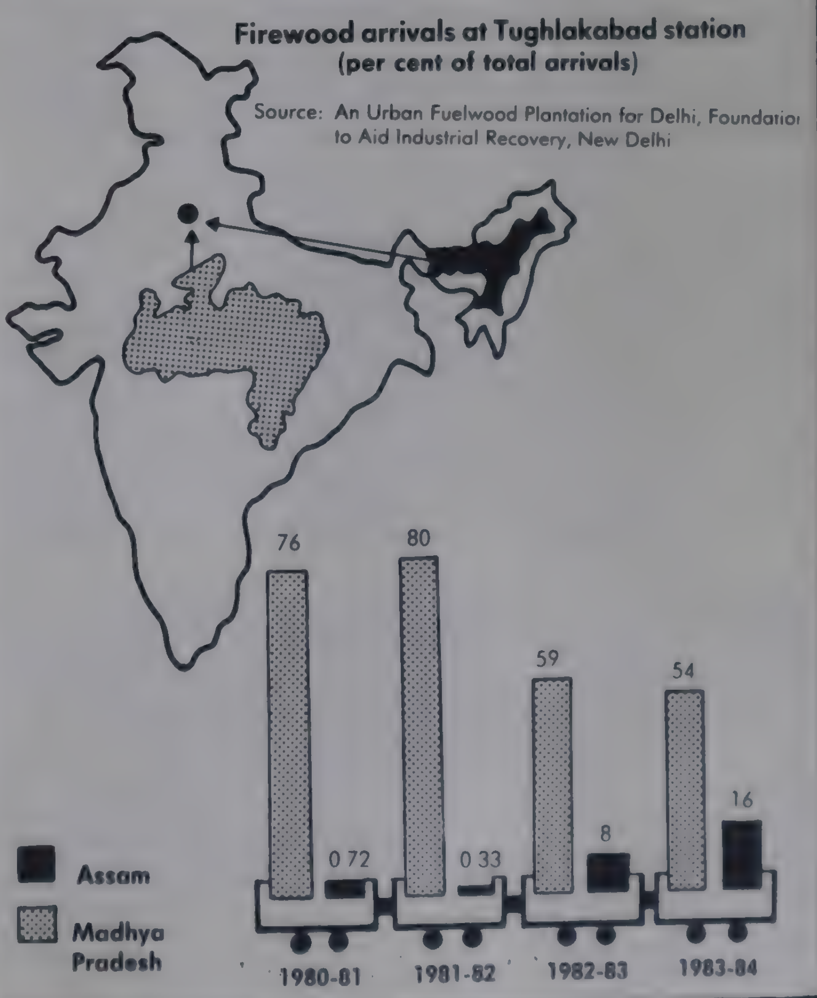
### Fuel Shock

Madhya Pradesh, the major firewood exporting state in the country, has become the first to ban the export of firewood. Imposed in August 1981 to bring down firewood prices in Madhya Pradesh and make more firewood available locally, the ban was challenged by firewood traders in the courts on the plea that they had already accumulated stocks of firewood purchased in state auctions unaware of any restrictions placed on them. The court asked the state government to allow the export of such accumulated stocks. The state government has since allowed firewood to be taken out of Madhya Pradesh only after a contractor has procured a transit pass and a no objection certificate from the forest department.

For some time, therefore, firewood has kept coming out of Madhya Pradesh and probably by bribing officials, transit passes have been obtained even for stocks of wood obtained after the ban was placed. But by late 1983 the quantity of the firewood going out of the state had dropped considerably. At the Tughlakabad railway station in Delhi, the total number of firewood wagons offloaded in 1983-84 had fallen precipitously to 7,577 wagons from 11,751 wagons in 1982-83 and 12,424 in 1981-82. In fact, less than five wagons are arriving from Madhya Pradesh daily.

Firewood traders in Delhi now have to go to Orissa, Bihar, Assam and Maharashtra to purchase firewood, with Assam becoming a major source of the firewood supplied to Delhi. There is little information about the effect of the Madhya Pradesh ban on firewood prices in various Indian cities. But, firewood prices in Delhi have definitely reached an all-time high, to Re one a kg, and would have gone up higher, had brick kilns not closed down because of the long strike by brick kiln workers. Retail shops are facing an acute scarcity of firewood and retailers allege that wholesalers are taking advantage of the situation by hoarding firewood to drive up prices further.

If Saudi Arabia had banned oil exports, every newspaper would have given it banner headlines. But until mid-1984, there was no report in the press about the firewood export ban, and the central government, too, generally seemed to be unaware of this ominous development. Which state will follow Madhya Pradesh's lead?



**Firewood arrivals at Tughlakabad station (per cent of total arrivals)**

Source: An Urban Fuelwood Plantation for Delhi, Foundation to Aid Industrial Recovery, New Delhi expenditure. The surplus has steadily risen from Rs 18.20 crore in1969-70 to Rs 60 82 crore in 1980-81. But the investment in forestry has been less than one per cent of total annual investment in successive state development plans. The expenditure on plantations and farm forestry has risen from Rs 19 lakh in 1974-75 to an abysmal Rs 1.42 crore in 1981-82. Less than one per cent of the state's earnings from forests have been allocated to afforestation.

Between 1951 and 1973 only 300 hectare of fuelwood plantation were raised in the state. Since the nationalisation of timber and firewood production there has been an enormous rise in forest staff, but few of them have been assigned to afforestation. The state has also failed to keep up investments. It has 22 per cent of the total forest area in the country, but only 7 per cent of the country's total allocation for forestry in the Fifth Five Year Plan has gone to Madhya Pradesh.

### Socio-economic consequences

The people of the state have begun to feel the social and economic consequences of ecological destruction. Firewood, fodder and small timber scarcity is being felt in many areas.

The state's current annual fuel consumption is estimated at 9.47 million tonnes of firewood, 9.64 million tonnes of cowdung and 6.93 million tonnes of agricultural wastes. But as this is ecologically an unhealthy situation—most of the cowdung and agricultural wastes should go back to the soil to maintain its fertility—the state's firewood consumption should optimally rise to 16 million tonnes immediately and 22 million tonnes by the end of the century. Even if the current consumption pattern of firewood, cowdung and agricultural wastes was to continue, total firewood consumption in the state would have to rise by about 40 per cent by 2000. Given the rapid destruction of forests it is unlikely that this amount of firewood will be found easily. A senior forest official in Bhopal points out that the Madhya Pradesh government had nationalised the forests with the intention of meeting the state's firewood needs by controlling the export of firewood to other states.

Even the investments envisaged during the Sixth Five Year Plan (1980-85) are extremely inadequate to meet the state's own timber, fuel and fodder needs: just about a quarter of the Rs 600 crore that ought to be spent. Planned afforestation levels are not even one-fifth of the desired level. The allocation to the forestry sector for the Sixth plan is again a little over 1.3 per cent of the total Plan outlay for the state, and this includes the additional funds which will be spent under the USAID supported social forestry project.

### Rising prices

Meanwhile, firewood prices in Madhya Pradesh have risen six to seven times in the last 20 years, to 30-40 paise per kg. Since the nationalisation of timber and firewood production, inexpensive firewood should theoretically be available at wood stalls set up by the forest department which generally sell if for about 20 to 25 paise per kg. As this firewood is often of poor quality, private stalls with better quality firewood selling at a higher price succeed in drawing away customers.

In the towns almost all sections of the population are heavily dependent on firewood. A study conducted by Awadesh Pratap Singh (APS) University, Rewa notes that firewood consumption among different income groups in Rewa, including those earning more than Rs 900 per month was almost uniform and ranged from 112 to 152 kg per month per family. Little cowdung, sawdust or LPG is used. The most used fuels are firewood, coal and kerosene, of which firewood is the most popular.

A survey conducted by a forest official in Jabalpur shows that firewood comes to the city on every conceivable means of transport; on trucks, trains, bicycles, bullock carts, tractors, on shoulders and as headloads. Sawdust generated by the city's sawmills is also used extensively. The city's population of 800,000 consumes about 7,500 tonnes of firewood every month. This is well below the national average of firewood consumption for urban areas. In other words, if more firewood were easily available, it would be consumed by the city.

### A political issue

Firewood scarcity now appears to have become an issue even in local elections. After the defeat of the ruling Congress (I) party in the parliamentary by-election in Sagar in 1982, Chief Minister Arjun Singh reportedly called a meeting of forest officials where he complained that firewood shortage in the city had been a factor in the ruling party candidate's defeat. He instructed them to ensure that the firewood needs of Jabalpur, where a by-election was imminent, were met. The party's candidate reportedly distributed free firewood to voters. During the election campaign period, local people were allowed as many headloads of firewood as they could gather from the neighbouring forests. However, the ruling party still lost the election.

Destruction of forests and growing firewood shortage is severely affecting the state's tribal population. The Benga tribals in the Bahyar area of Balaghat, for instance, used to practise shifting cultivation. Shifting cultivation is now restricted by the government, so is the collection and sale of minor forest produce like bamboo, honey and chironji etc. Industrial development is negligible in many of these areas; 17 Madhya Pradesh districts were classified as "no industry districts" in late 1982 by the central government.

For hundreds of thousands of tribals, collecting and selling firewood is slowly becoming a major occupation. If a town is nearby, they take their headload of firewood — about 20 to 25 kg per headload — directly to the town, where they earn about Rs 4 to Rs 5 per headload. Otherwise they bring the headloads to the nearest national or state highway and sell them to bus and truck drivers for Re one to Rs 2, who then make a profit by selling the wood in the towns for Rs 4 to Rs 5.

In Madhya Pradesh, local people have been given the right to enter forests to collect forest produce for bona fide domestic and agricultural purposes, but not for sale or barter. These rights, known as "forest nistar", are the source of headloads coming to town with the connivance of forest officials.

The helplessness of tribal communities whose erstwhile lifestyles have been destroyed and who have no alternative occupations, and the desire of forest guards to make quick money combined with the demand for firewood in energy-starved towns has created a self-perpetuating system which will be difficult to change. Many social workers argue that trying to stop the nistar system will further hurt the tribals, the poorest people of India.

It is difficult to estimate the amount of firewood being collected in the state's forests in the form of headloads. Former chief conservator of forests K.P. Sagreiya makes a rough guess of at least 50,000 headloads every day. This means at least 500,000 tonnes of firewood worth about Rs 10 crore are sold every year by tribal communities to sustain themselves economically, about a fifth of the amount sold officially by the forest department. Tribal income through firewood sales is several times more than the money allocated by the forest department for tribal welfare under the tribal sub-plan. In other words, firewood sales are a major source of income.

Yet these estimates of tribal income from headloads of firewood may in fact be on the lower side. A newspaper report in 1978 claimed that nistar material worth Rs 40 lakh was removed from the small Jabalpur forest division during that year. According to a study conducted by a Ph D student at the School of Studies in Environmental Biology, APS University, Rewa, unauthorised collection of timber, fuelwood and bamboo from the Kangsaura forest in Shahdol district was equal to 72 per cent, 56 per cent and 90 per cent respectively of the amounts collected on an authorised basis. Some 800 people were regularly and illegally collecting stacks of firewood of about 50 kg per day per person. These figures relate to just one forest. The state government estimates that the value of forest products collected freely by the people for their own needs is about Rs 24 crore annually.

Thousands of tribals who own bullock carts are involved in transporting firewood from the forests to the main roads and towns. For instance, some 500 to 600 bullock carts can be seen at any time transporting firewood between Roopgarh and Balaghat. But now with a vast network of roads being built by official agencies, trucks are increasingly being used to transport firewood thus reducing employment among tribals and increasing the bargaining power of contractors and forest officials.

Most forest officials clearly look upon this as an illegal activity and headloaders are often described as the scourge of forests. But illegal activities are extensively indulged in by local politicians and others who are widely involved in timber smuggling, often even in the guise of transporting firewood. This fact came to light a few years ago when one of the trucks supposedly carrying firewood overturned. Most of its load was expensive teak.

The state government has banned the export of timber and firewood to areas outside the state without government permission. Contractors purchasing timber or firewood at government auctions are given transit passes which they have to show at the state's border check-posts. But timber smuggling is common and often takes place with the connivance of forest officials. State Forest Minister A.N. Mushran recently admitted in the state assembly that numerous cases of illegal felling, amounting to Rs 80 lakh of timber, had come to light in one year. Twenty forest employees were killed and about 600 beaten up in these incidents.

Madhya Pradesh has a "forest army" consisting of 1,554 forest rangers, 6,362 foresters, 16,255 trained forest guards, 7,606 untrained forest guards and 2,736 coupe guards. Though many of these people work in league with timber smugglers, many of them have also risked their lives to prevent timber smuggling. Given the number of armed attacks on them, the state's Forest Guards Association has pleaded that the government give them arms.

The state government bought 200 guns at a cost of Rs 9 lakh for forest employees posted in sensitive forests. Squads of forest guards, on the lines of the special armed force of police, will be posted in those forests. The forest minister hoped that these measures would prevent illegal felling.

It is equally true, however, that many poor tribal people including women, are ill-treated and brutalised by forest officials. The latter are feared and enjoy little credibility with the local people who have to depend on the forests for survival. This gives the officials enormous power over their daily lives. The state government's steps to prevent timber smuggling could easily lead to increased problems for tribals.

How can growing firewood needs be met? The immediate response of many forest conservators concerned about the destruction of forests is to demand an end to nistar rights or to strictly restrict them to bona fide personal needs of the people. But this will only create more tension between the poor and the forest bureaucracy and further curtail the meagre earnings of the tribals.

On the contrary, a sensitive forest management policy could transform the emerging ecological disaster into a basis for both ecological and economic regeneration. If a forest management system can be found in which the poor get guaranteed earnings by growing their own trees and meeting the growing energy demands of the urban population, they will have an interest in forest renewal and the crores of rupees pouring into the rural areas, could lead to general economic advancement as well. The challenge is vast but so are the stakes.

**Even desert cities like Bikaner are voracious consumers of firewood which they draw from miles around on camelbacks. (T. Sennett/FAO)**

# ANIMAL ENERGY

The figure is humbling for a technology-proud society. Over half of all energy consumed on India's farms comes from the muscles of hardworked animals. India has about 80 million work animals — 70 million bullocks, 8 million buffaloes and a million each of horses and camels. In addition, donkeys, elephants and yaks are also used as work animals. If each of these animals generates 0.5 horsepower (hp), the 'installed capacity' of the animal labour force comes to 40,000 hp or about 30,000 mw, which is equal to the installed capacity of electric power generation in the country. To build up this power generation capacity, India has invested Rs 30,000 crore: in comparison, estimated total investment in work animals and the associated infrastructure is only Rs 10,000 crore.

Total investment in the 15 million-odd animal drawn carts in India—12 million in the villages and 3 million in the towns—has been estimated at Rs 3,000 crore. This compares respectably with the outlay on the railways (Rs 4,500 crore) and on the public transport system (Rs 2,500 crore). About 20 million people are involved in part time or full time in the bullock cart business. And, the country's bullock carts carry an estimated 15,000 million tonne-km of freight as compared to 100,000 million tonne-km by motorised trucks and 200,000 million tonne-km by the railways.

This massive contribution to the energy pool has usually gone unsung, and only lately have the experts woken up. For instance, half a dozen laboratories have been working on the improvement of bullock carts. In 1976, in a blaze of publicity, the Ministry of Shipping and Transport announced the setting up of a steering committee to coordinate research and development on bullock carts. The demand for pneumatic-tyred bullock carts is in fact already quite heavy in all those areas which have prospered in the Green Revolution, like Punjab, Haryana and western Uttar Pradesh.

The Indian farmer's reliance on bullocks and buffaloes will definitely continue. Dr N.S. Ramaswamy, one of the strongest proponents of bullock carts and director of the Indian Institute of Management at Bangalore (IIMB) points out that over half the farm holdings in India are less than 2 hectares: they can never use tractors. Similarly, only half the villages have paved roads on which trucks can ply. Only animal-drawn carts can ply unprepared surfaces, indeed on any kind of terrain: ravines, streams, paddy fields and so on.

### Versatile vehicles

Given those kind of conditions, it is not surprising that experts are discovering fresh virtues in the lumbering vehicle. Scientists say it is an extremely versatile vehicle which has evolved to a state of perfection and admirably suits the kind of roads and terrain where it is used. The bulk of the rural produce is carried to market towns on bullock carts: tractors and trucks are simply too uneconomical for the modest freight carried between villages. Camel carts played a crucial role in construction of the Rajasthan Canal. Without them, the cost would have risen substantially, as modified motor vehicles would have had to be used to tackle the sand.

Another argument in favour of animal power is that it is the only cheap renewable energy source. Solar and wind energy systems and biogas plants will take decades to meet the needs of the rural poor. Says Dr Ramaswamy: "Whatever efforts are now going on regarding animal energy are only a fraction of what is needed, considering the vast existing investment and the vast potential of economic benefit to the country."

So bullocks are going to be around for quite some time. The National Commission on Agriculture has pointed out that India can expect bullocks to be maintained at the existing level even by the turn of the century, even though the contribution of animal power as a percentage of the total available farm power may fall to about 20 per cent. Peasants with land holdings of less than 5 hectares, which account for about half of India's total cultivated area, will continue to depend upon bullock power more heavily than others. They can benefit from mechanical power only if it is cheaply available and on a hire basis, such opportunities will clearly be limited.

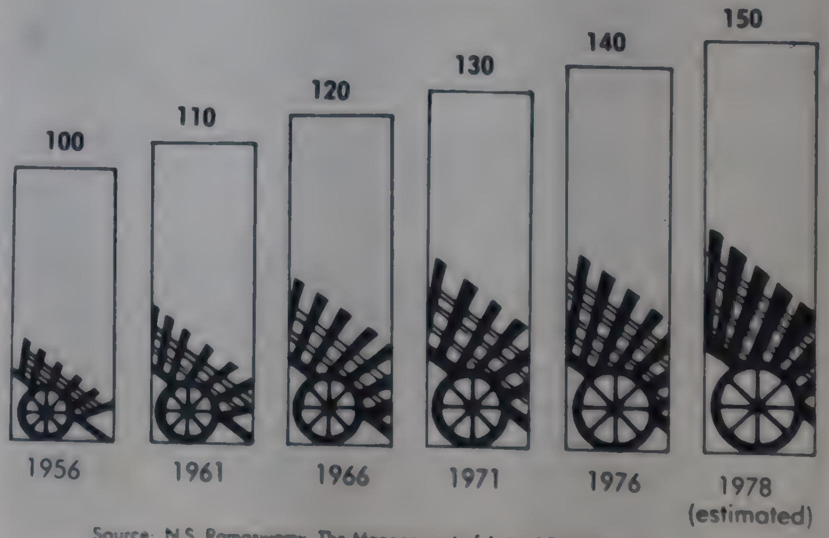
Farmers with operational holdings greater than 20 hectares will be less dependent on bullock power. But even highly mechanised farms in western Uttar Pradesh, Punjab and Haryana keep a few pairs of bullocks to perform small agricultural tasks and for emergencies caused by mechanical breakdowns and scarcity of fuel.

The population of both carts and work cattle is increasing, except in Kerala and Punjab, where machines are replacing animals. In Kerala, an additional factor in the decline is the increase in the demographic pressure on land, because of which the number of small farms has grown considerably. Peasants continue to cling to these small pieces of land as their main source of subsistence. But the growing economic attraction of milk production is resulting in the substitution of draught animals by milch animals and the development of dairying as the source of supplementary income for rural households. As a result, a bullock rental market is also emerging in Kerala's rural economy.

Surveys show that the number of animal-drawn carts is increasing in many towns, as distinct from metropolitan cities, where bullock carts are discouraged. In the urban areas, the proportion of goods carried by carts is predictably much smaller than that carried by motorised transport. But carts are able to compete with trucks in cities when the distance is short, the load is less than 60 per cent of a truck's capacity, loading and unloading time is long compared to the journey time, and the roads are narrow.

**Growth in cart numbers—1956-1978**

**(numbers in lakhs)**



Source: N.S. Ramaswamy, The Management of Animal Resources and the Modernisation of the Bullock Cart System, IIM, Bangalore 1979

India's one million camels — seven per cent of the world's total — are important work-horses in desert areas. Camels have even played a major role in the digging of the 649 km Rajasthan Canal, India's biggest irrigation project. (T. Loftas/FAO)

**Inefficient construction**

"The problem before us is not how to get rid of the bullock cart but how to make it more efficient," argues Dr Ramaswamy. The conventional cart has a range of only 5 miles to 10 miles with a load-bearing capacity of 750 kg; it uses only half the animal's energy output. The wooden wheels have rough bearings which increase friction. The cart's enormous weight reduces its carrying capacity as well as its speed.

Here the animal suffers greatly. The harnessing device consists of two wooden beams attached to a yoke which sits heavy on the bullock's neck, pulling it down with a force of 100 kg even when only 60 kg is being carried. The animal not only pulls the cart but carries a great deal of it: studies reveal that the weight on a harnessed animal ranges from 50 to 120 kg while standing, and increases considerably when the cart moves. The yoke is generally made of rough hardwood and bruises the soft neck-skin, producing a cancerous neck-gall. Because of the heavy yoke the working life of the animals is often reduced by as much as one-tenth. Apart from the cruelty, the national loss resulting from the loss of one year of every animal's working life amounts to about Rs 200 crore. What is needed is a good suspension yoke as in horse carts, which by its floating action would eliminate the vertical load on the bullock.

Another major defect is that the cart has no brake. In Kerala, a log of wood is hung at the rear and connected by a rope to the reins. The log can thus be manoeuvred by the carter. This device is commonly used in the hills. Another variation uses two logs of wood in the front and the rear of the wheels, and is worked through a pulley. At present the animal's neck is used to slow down the cart or to stop. The neck is also strained whenever the cart has to be turned sharply: one animal is made to stop and serve as a pivot round which the other animal is made to turn. The bullocks suffer greatly in the process. Carters also use nose ropes for manoeuvring the animals. This, too, is unnecessary: in Andhra Pradesh, where there are almost a million carts in use, the rope is taken round the mouth and the horns.

The first group to push the idea of pneumatic-tyred carts was the multinational firm of Dunlop which began its campaign long ago in the 30s. The campaign, however failed, partly because the farmers were too poor, and partly because it was not motivated by any desire to help the peasants. In fact, the campaign started because the then British government wanted to save newly developing road system in the country from damage caused by the wooden wheels of the bullock cart and was prepared to provide a system of subsidies and penalties to promote pneumatic tyres. The traditional bullock cart wheel because of its small thickness damages the road almost 10 times more than pneumatic tyres.

The growth of the organised market sector and the paved road network since independence has made the pneumatic-tyred cart more viable and popular. Incidentally this kind of cart is good only for well-paved roads. A study made at the Indian Institute of Science (IIS) Bangalore firmly concluded that for normal slushy, muddy village roads, full of potholes, there can be no better bullock cart design than the traditional one with big wooden wheels. The large diameter of these wheels makes it very easy for them to negotiate the obstacles. Another multinational tyre company, Firestone has been advocating, unlike Dunlop, solid rubber tyres to be fitted on to the large diameter wooden wheels. This will increase efficiency even on those village tracks which pneumatic-tyred carts find hard to negotiate.

The pneumatic-tyred carts will continue to capture an important segment of the bullock cart market because the road network is expanding rapidly. Moreover, an estimated

With 80 million work animals, the animal labour force equals the energy generating capacity of India's electric power stations. (F. Botts/FAO)

4 million to 5 million bullock carts ply today within towns and between towns and villages well connected by roads. If n the next decade these carts could be modernised, a major advance would have been made in animal transportation.

Replacing wooden wheels by pneumatic tyres helps to increase the carrying capacity of carts from 750 to 2,500 kg. Earnings of "Dunlop" cartpeople have, thus, increased from Rs 6 to Rs 10 to Rs 20 to Rs 40. Even banks are now willing to finance the purchase of modernised carts. Although investment in tyred bullock carts is about double that of the older type, they give a 30 per cent return against the 5 per cent return usually obtained from traditional carts. Four-wheeled tyred carts are becoming popular now in several areas. They can carry 3,000 kg to 4,000 kg without any additional burden on the beast. There are probably half a million tyrised carts in the country.

Dr Ramaswamy believes that many farmers would prefer a cart with a carrying capacity of 1,500 kg pulled by a single bullock. In fact, buffalo carts, pulled by just one buffalo are becoming extremely popular in many areas. A buffalo cart is 40 per cent cheaper than a bullock cart, one buffalo costs less than two bullocks and can pull upto 3 tonnes of cargo. The buffalo clearly remains a neglected animal in development programmes. Both as a milch and draught animal, its potential is enormous.

### Detailed study

Meanwhile, the Bangalore based Cell for the Application of Science and Technology to Rural Areas (ASTRA), has prepared a detailed study on the use of bullock carts in one village, Ungra, which challenges Dr Ramaswamy's argument that research should aim to produce bullock carts with a higher load-bearing capacity. The local terrain in Ungra is typical of Indian villages. Over a fourth of the bullock cart transport is over unprepared terrain, for example, through crop land where there are no prepared roads and not even cart tracks. In this terrain, the carts have to negotiate obstacles such as bunds and swampy land. The remaining three-fourth of bullock cart transport is on 'prepared' roads, but many of these roads are simple cart tracks which have come to be established over long periods of cart usage.

But the rising prices of wood, and especially teak, used to make the spokes of bullock cart wheels, has so increased the price of traditional carts that even in Ungra, farmers prefer to buy modern pneumatic tyred carts, or if they are too poor, are content with purchasing second hand traditional carts. A forced technological modernisation is taking place in Ungra . But ASTRA experts are not sure if this development is good for the majority of the farmers.

Ungra has about 150 households, of which one-third are landless and own no bullock carts. Every second land owning household has a cart. Large and medium farmers (those owning more than 2 hectares) possess over two-thirds of the total number of carts even though they comprise slightly less than one-third of the households. They also possess all the seven pneumatic tyred bullock carts. Nearly 90 per cent of the tonnage carried by bullock carts consists of agricultural inputs and produce. Also the number of carts owned by a family tends to increase with the size of its landholdings. Bullock carts in Ungra lie idle on most days. An average cart is used for 21 days in a year. The peak use is during the harvesting season when a large number of carts are even obtained on hire by Ungra villagers.

The ASTRA scientists calculate that a new traditional cart would have to be used for at least 43 days for it to break even and new modern carts would have to be used at least 30 days. Therefore, most farmers with small landholdings cannot afford even the lower-priced, modern bullock carts. Some money could be earned by renting them out, an increasingly common practice in Ungra, but for such a large investment to be recovered entirely on the basis of hiring out is risky because of the limited rental market.

In the changing post-oil price rise bullock cart market, a demand for second-hand traditional carts has suddenly emerged in a big way, to the benefit of small farmers. A tyre cart is preferred only by those households which have large enough holdings so that their 75 per cent extra loadbearing capacity is important; the extra 3,000 investment over a second-hand traditional cart is not a burden; and the smoother ride they give to passengers on the rare occasion they are used for human transport is worth paying for. Bullock carts now are rarely used for transport as the village is connected by a bus.

### Turning Cartwheels

Bullock cartwheels made in the Chattisgarh region of Madhya Pradesh are sold not only in other parts of the state but also in other states like Orissa, Maharashtra and Andhra Pradesh. In all of Chattisgarh, some 25,000 pairs of cartwheels are made every year. In Badhaipara of Raipur district alone, where the trade is concentrated, some 20,000 pairs of cartwheels are made.

Badhaipara has been a cartwheel centre for over a century now. Even though many industries have come to Raipur, the cartwheel industry remains concentrated in Badhaipara. An interesting thing about this trade is that it remains dominated by carpenters from Ghazipur and Ballia districts of Uttar Pradesh.

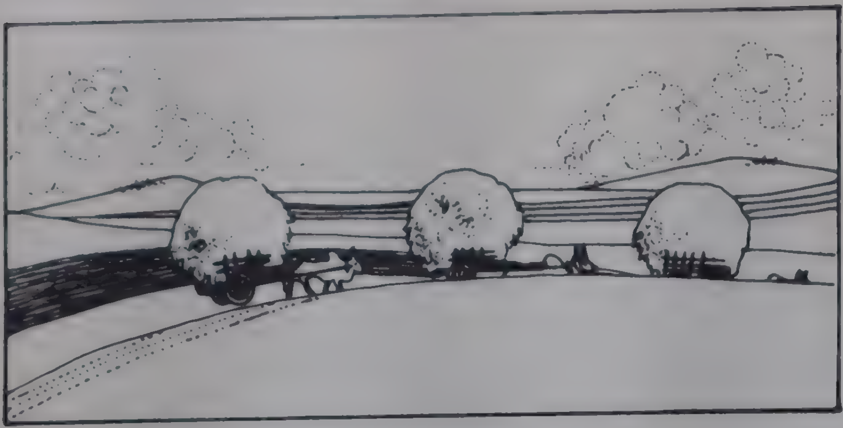
Nearly 100 years ago, when there was no railway in the area, a few carpenter families from Bihar and Uttar Pradesh settled here. Together with other wood products, they began to make bullock cartwheels and soon their fame came to be known far and wide. Some 200 families in Badhaipara continue to be involved in this trade even today.

Earlier, the wheels used to be sawn by hand. Since 1955, a number of machines have been introduced. With their introduction, a carpenter can make a pair of wheels in one day; in the machineless era, three carpenters would take three days to make a pair. About 500 kg of wood goes into one pair of wheels, which costs about Rs 100. The total profit on a pair is between Rs 15 and Rs 30.

The total trade in Badhaipara amounts to Rs 50 lakh, which includes the cost of labour and raw materials. There is no sales tax on bullock cartwheels. Nationalised banks also grant loans to the industry.

Acacia cart wheels last between seven and 10 years while teak ones last 40 to 45 years. Most people prefer acacia cartwheels because they are cheaper. In fact, the main raw material is acacia wood, which comes on trucks and bullock carts from forests situated on the banks of the Mahanadi and other rivers. The Raipur market gets about 10,000 tonnes of wood every year, of which 8,000 tonnes are transformed into cartwheels. Unfortunately wood is becoming scarce because of deforestation. If the cartwheel industry is to survive, acacia trees will have to be planted on a massive scale.

The other raw material is iron and subsidised rates for the metal would help greatly. The carpenters would also earn more money if the government were to invite quotations for bullock carts directly from them instead of contractors—bullock carts are distributed to villages by the government for rural development programmes.



The major conclusion of the report is that research and development on bullock carts aimed at increasing speed and load bearing capacity by putting on pneumatic tyres is irrelevant in most villages, especially as these modifications increase costs considerably. "At best, this research may come up with carts which medium and large farmers can afford but which are beyond the reach of marginal and small farmers," says the ASTRA report. Where the increased load bearing capacity is needed, as in the commercial urban bullock cart market, the modern pneumatic-tyred carts are being adopted rapidly.

**Cheap solutions**

But what Indian villages need most are cheap vehicles capable of operating on both prepared and unprepared terrain with a speed of about 5 km per hour. "At these low velocities, it is a moot question whether the shock-absorbing properties of pneumatic tyres can be fully exploited. There is an enormous overkill involved in using pneumatic tyres designed for vehicles travelling at 50 km to 100 km per hour for an animal drawn cart going at 5 km per hour," says the Ungra study. Hard rubber lined wheels made of cheaper and properly treated and seasoned wood other than teak, may be one cost effective solution.

Increasing load-bearing capacity is also not important. An average cart of 400 kg capacity is economical only for a family owning more than 5 hectares of land. Only 5 per cent of the households in the village are of large farmers, owning more than 6 hectares. For smaller farmers, a cart with only 200 kg load bearing capacity would be adequate as long as the price could be brought down to Rs 1,200, a fourth of the present cost and close to the cost of second-hand carts. "The aim of R&D should be to make carts economically viable for households with much smaller landholdings than 5 hectares," says the report.

An important aspect of improving the animal energy system will have to be proper management of the country's animal wealth. The Royal Commission on Agriculture which studied the problem in the 30s had concluded that improvement in the working efficiency of cattle could be brought about by better feeding and breeding and also that the primary role of cattle was as a supplier of bullock power for cultivation and transportation. In the last 30 years, several committees have emphasised that cattle breeding programmes should enhance both draught and milking qualities and one quality should not be developed at the expense of the other. However, most breeders today are just interested in increasing milk yields. But the indigenous high draught varieties need to be carefully preserved for possible breeding programmes in the future.

Together with appropriate breeding programmes, the government will also have to ensure that there is enough fodder and feed for the work animals. This will demand better management of the country's grazing lands and a massive plan for afforestation with species that can be used as fodder. Succinctly put, the objective of all animal programmes should be to ease the burden on the hardworking beasts.

**Cart Power**

In 1977–78, the National Council of Applied Economic Research (NCAER) in New Delhi carried out a detailed survey of animal carts in north India at the request of the Ministry of Shipping and Transport. The survey covered 200 villages in 100 districts spread over seven states. It confirmed the well known importance of animal carts in the rural economy, and also revealed that the number of animal carts being acquired every year is going down, though the study gave no reasons for this trend.

The survey found that Punjab, Haryana, Rajasthan, Gujarat, Uttar Pradesh, Bihar and West Bengal had a total of 6.4 million animal carts in 1978. Since the 1972 Livestock Census had put the cart population in these states at 5.2 million, the population has clearly been increasing at a rate of 2 per cent per annum. But the age distribution of the carts also revealed that the net annual addition to the cart population had declined from 662,000 in 1972 to about 169,000 in 1977. If this trend continues, the cart population could soon reach saturation point in north India.

Over 75 per cent of the carts in this region are bullock carts, about 18 per cent buffalo carts and about 4 per cent camel carts. Ownership is highly skewed. Of the 38 million households in the region, only 17 per cent owned carts, and nearly three-fourths of the carts were owned by households in the income group Rs 3,001 to Rs 12,000. Households with operational landholdings of less than two hectares owned less than 15 per cent of the carts in the region, even though they accounted for nearly two-thirds of the households. Carts are mostly used for pesonal use but about a tenth are also hired out. Nearly half the households use animal carts for transportation. Only a third of them own bullock carts, and the others have to borrow.

The NCAER survey estimated the total volume of rural traffic at 2,367 million tonne-km, of which 1,434 million tonne-km (61 per cent) was being met by animal carts. An enormous quantity of goods like farmyard manure, fodder and crop roughages are moved around within the villages for farm and household purposes, and mainly over "katcha" (unpaved) roads. Animal carts play a particularly important role in this household transport, their share being 72 per cent of the total traffic within the village and 66 per cent of that outside the village. For goods transport outside the village, the share of tractor trailers went up to 27 per cent. Similarly, on katcha roads, animal carts claimed over 75 per cent of the total transport, whereas on "pucca" (tar) roads their share dropped behind that of tractor trailers.

Improved carts were already carrying as much as 30 per cent of the total animal cart traffic in 1978 but their use is heavily dependent on the nature of the road. On pucca roads, improved carts carried 55 per cent of the traffic whereas on katcha roads, traditional carts carried 72 per cent. In Punjab, Haryana and western Uttar Pradesh, the more developed parts of the region, over 80 per cent of the carts were of the improved type whereas in the rest of the region such carts formed barely 15 per cent of the total population.

A large number of peasants were eager to purchase improved carts but less than a third were prepared to pay over Rs 2,000 for one. Only those who used their carts intensively were found to be interested in more expensive improved carts, and these are generally the richer peasants, the study found. Cart usage increased from 48 days for peasants with an income of less than Rs 3,000 per annum to 129 days for those whose annual income exceeded Rs 15,000. Low income peasants hired their carts out far more frequently than the richer peasants.

# NUCLEAR ENERGY

The dream began with Homi Bhabha's vision in the mid-1940s of unlimited nuclear power for India. Today the Rs 1,800 crore nuclear empire consists of just about everything: uranium mines, fuel fabrication factories, heavy water plants, nuclear power stations and spent fuel reprocessing plants. Inaugurating India's fifth and latest nuclear reactor, the first unit of the Madras Atomic Power Project (MAPP.I) which authorities claim is 90 per cent indigenous, Prime Minister Indira Gandhi declared: "some countries have attempted to prevent India from becoming technologically strong ........ The successful completion of MAPP I is an example of our determination to be self-reliant."

The Atomic Energy Commission (AEC) is one government organisation which is never short of money. In every five year plan, it gets from 2 per cent to 5 per cent of the power sector's share and in every annual budget of the Central government, about 15 per cent to 25 per cent of the total investment in research and development.

India today has five nuclear reactors in operation — two each at Tarapur (Maharashtra) and Kota (Rajasthan) and one at Kalpakkam (Tamil Nadu)—with a combined installed capacity of about 1,095 mw, representing about 2.5 per cent of the total power capacity in the country. Five more units are under construction at Kalpakkam, Narora (Uttar Pradesh) and Kakrapar (Gujarat). The site of the sixth station has yet to be announced but according to M.R. Srinivasan, chairman of the Nuclear Power Board, it will probably be sited in the south.

### Support facilities

A large number of organisations across the country support the nuclear power programme. The oldest and the most prestigious nuclear establishment is the Bhabha Atomic Research Centre (BARC) at Trombay, the fountainhead of India's research on light and heavy water reactors. It also operates several research reactors. The country's second nuclear research centre is the Reactor Research Centre (RRC) at Kalpakkam near Madras, which concentrates on fast breeder reactors. Together these institutions spend Rs 60 crore to 70 crore annually and employ over 12,000 people.

**Outlays on power sector and on nuclear power**

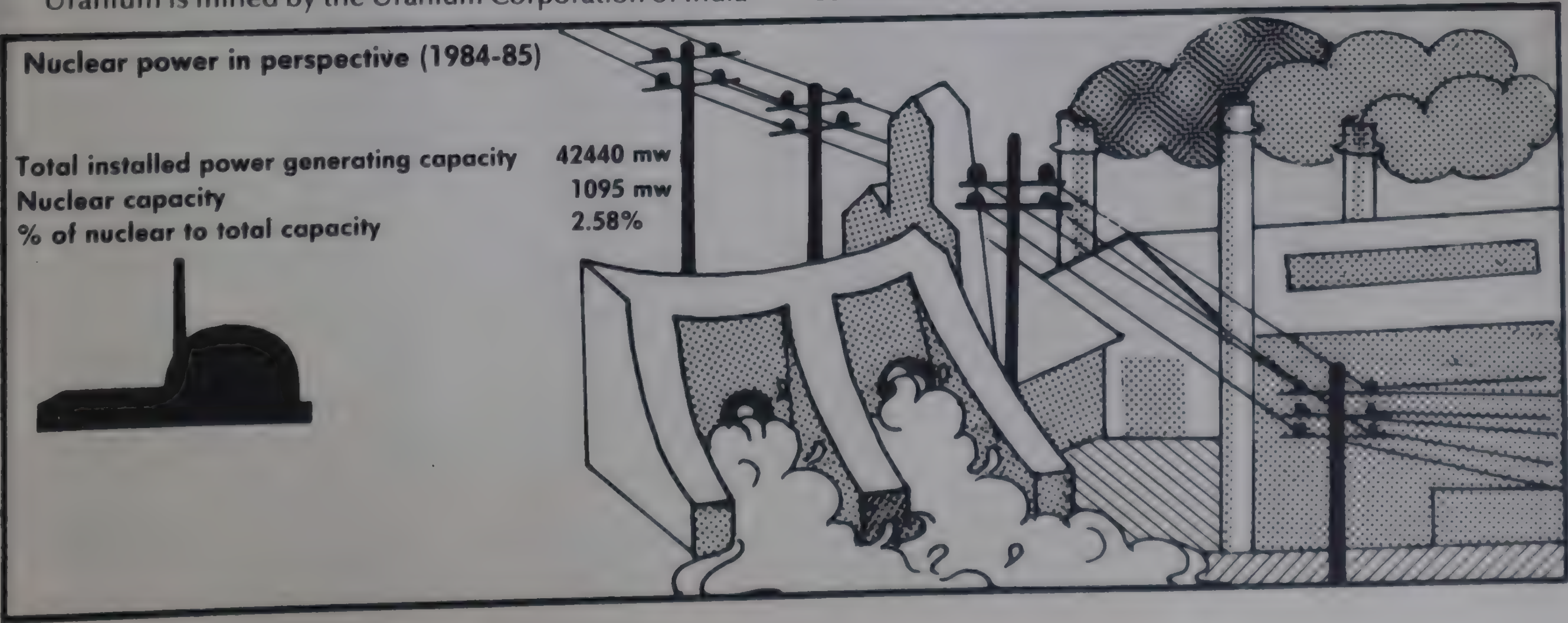
| | IV Plan (1969-74) | V Plan (1974-79) | VI Plan (1980-85) |
|---|---|---|---|
| Outlay on conventional power sector (A) (Rs crore) | 2932 | 6190 | 19,265 |
| Outlay on nuclear power programme (B) (Rs crore) | 161.9 | 268.8 | 450 |
| B/A (%) | 5.5% | 4.3% | 2.3% |

Source: Sethna, H.N. and Srinivasan, M.R., India's Nuclear Power Programme, IAEA-CN-36/385 Vienna and Sixth Five Year Plan (1980-85)

Uranium is mined by the Uranium Corporation of India at Jaduguda in Singhbhum, Bihar. The mine and its associated mill are capable of processing 1,000 tonnes of uranium ore every day. The corporation is planning to open two more mines shortly at Narwapahar and Turamdih, near Jamshedpur, at a cost of about Rs 100 crore to meet the fuel needs of the new power stations. The uranium mined is sent to the Nuclear Fuel Complex (NFC) at Hyderabad where it is fabricated into pellets and enclosed in zircaloy tubes, to make fuel rods for nuclear reactors at Kota and Kalpakkam. The zircaloy is made at the NFC using zirconium sands from Kerala. The enriched uranium for the light water reactors at Tarapur is imported and is fabricated at NFC.

Except for the Tarapur reactors, all others operating and under construction are of the CANDU type and use heavy water. Even though they are more capital-intensive, CANDU reactors were preferred by the AEC to light water reactors because they are fuelled by natural uranium, which can be manufactured at home. This makes India independent of foreign suppliers, obviating the kind of international pressure it has had to face for the supply of enriched uranium fuel for Tarapur.

But this strategy will work only if India can produce enough heavy water. India has three heavy water plants in operation—Nangal (14 tonnes), Baroda (67 tonnes) and Tuticorin (71 tonnes)—with a total installed capacity of about 150 tonnes a year. Two more plants are being commissioned at Kota (100 tonnes) and Talcher (62 tonnes). The country has spent Rs 220 crore on these five plants. Two more large plants are being undertaken at Thal (110 tonnes) and Manuguru (185 tonnes) at a cost of Rs 188 crore and Rs 422 crore respectively and a third one at Hazira is being considered.



**Nuclear power in perspective (1984-85)**

| | |
|---|---|
| **Total installed power generating capacity** | **42440 mw** |
| **Nuclear capacity** | **1095 mw** |
| **% of nuclear to total capacity** | **2.58%** |

### Achilles' heel

Heavy water is turning out to be the Achille's heel of India's nuclear power programme. Except for the Kota plant, all the others were set up with the help of foreign contractors. Nangal was built by West German contractors and Baroda and Tuticorin by a consortium of one Swiss and two French firms called GELPRA. The plants at Baroda, Tuticorin and Talcher use the ammonia-hydrogen exchange process and work in tandem with fertiliser plants. Only one plant using this process has operated in the world: a 20 tonne per year plant built by GELPRA at Mazingarbe in France which operated from 1968 to 1972. The plant at Tuticorin and Talcher are thus being built with insufficient operational experience.

Most of the world's heavy water has been produced in the US and Canada using a hydrogen sulphide/water exchange process. However, the US and Canada were not willing to share know-how with India and Indian engineers had to design the process themselves. The construction of the 100-tonne plant at Kota was taken on without first building a pilot plant to gain experience on a limited scale.

All the heavy water plants, except the tiny one at Nangal, are problem-ridden. Design faults led to an explosion at the Baroda plant during trial runs in 1977 and it was put out of action until 1981. The plant's performance is said to have improved in recent months but has been well below 50 per cent of capacity. The Kota plant has yet to start commercial operation. The Talcher plant was delayed by two years because of the loss of two exchange towers, which reportedly fell into the sea off Portugal from the ship which was transporting them in 1975 from West Germany. The construction of this Rs 66 crore plant began in 1972 but it has yet to produce heavy water. The Tuticorin plant operated for only a few weeks during 1978 and 1979 because of technical problems and a labour dispute. In 1983-84 this plant worked at about a third of its capacity and, according to Srinivasan, it has now had "good steady long runs". Exposing the poor performance of the four large heavy water plants, Praful Bidwai pointed out in the 'Times of India' that despite their total capacity of 301.2 tonnes a year they have so far yielded less heavy water than has the tiny 14-tonne a year Nangal plant.

### Toxic wastes

The highly toxic radioactive wastes generated by nuclear power plants pose the biggest headache to the nuclear industry. The wastes have not only to be handled extremely carefully during the separation of plutonium but also have to be stored for thousands of years. Many believe that a final solution to the problem will never be found.

India's strategy is to build waste reprocessing plants near the atomic power stations to reduce the need for transporting the dangerous substances over long distances. A large reprocessing plant went into operation recently at Tarapur to process the spent fuel from the Tarapur and Rajasthan power stations. Another plant is expected to start up soon at Trombay. A third is under construction at Kalpakkam and should be in operation by 1991.

Once the plutonium is separated out, the AEC plans to immobilise the high-level wastes by vitrifying (glassifying) them. The vitrified wastes will be stored in special air-cooled structures for about 20 years. They will have to be stored finally in a place where they will remain undisturbed—by water, earthquakes, war or saboteurs—for thousands of years and it is not easy to find suitable sites. The Himalayas, the Indo-Gangetic alluvial plains, the Thar desert and the Deccan plateau have been ruled out either because of extensive ground water aquifers or seismic risk. But AEC scientists believe that the crystalline terrain of the Bundelkhand region in Uttar Pradesh and Madhya Pradesh and of a few adjacent districts in Andhra Pradesh and Karnataka may offer suitable sites. Areas in Karnataka and Andhra Pradesh are being investigated. An experimental research station has been set up in the unused section of an underground mine at Kolar near Bangalore. A pilot repository for permanent disposal of the wastes is planned to be built towards the late 1990s.

### Future plans

India's nuclear power strategy is divided into three distinct technological phases. The first and current phase calls for a series of natural uranium-fuelled nuclear reactors, and is limited in its scope because uranium is in short supply in the country. It was earlier estimated that available uranium resources would support a natural uranium reactor programme of 5,000 mw to 8,000 mw. But, according to the AEC, recent explorations and discoveries indicate that a much larger programme of natural uranium fuelled reactors is possible.

However, if India wants tens of thousands of megawatts of nuclear power, to meet a reasonable fraction of its total

**Anticipated and actual costs of nuclear power stations**

| | Estimated on sanction (crore) | Cost on completion/ currently anticipated (crore) | Sanction year | Planned year of completion | Actual/ anticipated year of completion |
|---|---|---|---|---|---|
| TAPS — I & II | 72 | 72 | 1964 | 1969 | 1969 |
| RAPS — I | 34 | 73.3 | 1964 | 1969 | 1973 |
| RAPS — II | 58.2 | 102.5 | 1967 | 1972 | 1980 |
| MAPS — I | 61.8 | 123.6 | 1967 | 1974 | 1983 |
| MAPP — II | 70.7 | 116.8 | 1971 | 1976 | 1985-86 |
| NAPP — I & II | 209.9 | 376.4 | 1974 | 1981<br>1982 | 1987-88<br>1988-89 |
| KAPP — I & II | 382.6 | 382.6 | 1981 | — | 1990-91<br>1991-92 |

Source Srinivasan, M.R. et al, Nuclear Power Generating Costs, in Nuclear Power Experience, IAEA, Vienna.

power requirements in the next century it will have to move to non-natural uranium fuelled systems. Thus, in the second phase, the AEC's strategy is to set up fast breeder reactors fuelled by plutonium to be obtained by reprocessing the spent fuel from the natural uranium-fuelled reactors. Few countries in the world have set up fast breeder reactors and many believe that this technology will never become safe or economical enough.

But the AEC is so ambitious that the second phase will be a stepping stone on the way to a third phase in which thorium-fuelled fast breeders will be built on a large scale. The plutonium-fuelled breeders of the second phase will not only produce electricity but also convert thorium which cannot be used directly as fuel, into uranium-233 (U-233), a reactor fuel. No country has yet built or thought of building U-233 fuelled fast breeders and this is an area where India will have to do all the research itself. But India has vast reserves of thorium in Kerala and Orissa and the AEC believes that once this phase is reached, India can theoretically enjoy unlimited amounts of electricity.

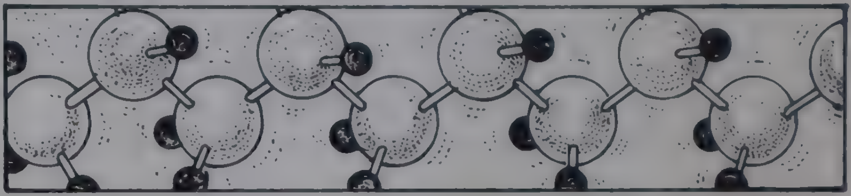
In April 1984, the government cleared an extremely ambitious nuclear programme which aims at 10,000 mw of installed nuclear capacity by 2000 at a cost of Rs 14,000 crore. Apart from the 10 units already commissioned or under construction the AEC proposes to build and commission 12 more natural uranium-fuelled reactors of 235 mw each by 1995-96, 10 units of 500 mw between 1996-97 and 2000-01 and a 500 mw plutonium-fuelled prototype fast breeder reactor in 2000-01. By then the country's nuclear capacity would reach about 10 per cent of the total power generation capacity.

The AEC hopes to commission the 13 mw Fast Breeder Test Reactor being built at Kalpakkam in late 1984. BARC recently announced that it had developed a mixed uranium-plutonium carbide fuel for it which it had to develop itself because of the prohibitive prices quoted by France for its mixed plutonium-uranium oxide fuel. BARC also claimed that it had been able to breed U-233 from thorium and intended to use the available material to fuel a small research reactor "Kamini" at Kalpakkam, in preparation for the third phase of the strategy.

**Proportion of Indian government R&D going to atomic energy**

| | Total Central govt. R&D (Rs crore) | % going to DAE R&D |
|---|---|---|
| 1955/56 | 12.1 | 14.3 |
| 1960/61 | 29.9 | 25.7 |
| 1965/66 | 79.1 | 25.3 |
| 1970/71 | 144.9 | 19.8 |
| 1975/76 | 250.0 | 21.6 |
| 1978/79 | 413.2 | 14.8 |

Source: David Hart, Nuclear Power in India; A Comparative Analysis, George Allen and Unwin, London 1983 and the Department of Science and Technology



The AEC has the full support of the government. The environmental considerations that have led to widespread public protest against nuclear power in the West do not appear to have moved official circles in India. But today there are growing doubts, even in official circles, about the AEC's ability to deliver.

## A Glossary of Nuclear Terms

**Enriched fuel** Uranium which has had its proportion of fissionable U-235 increased from the naturally occurring level of less than one per cent to a level of 3-4 per cent for commercial power reactors, or 98 per cent for military use.

**Fission** In this process the nucleus of a uranium-235 atom breaks apart into fragments plus heat and some free neutrons. These neutrons in turn break up the nuclei of other atoms. A chain reaction starts which becomes self-sustaining. The heat produced in this process is used to boil water to produce steam, which drives a turbine and generates electricity.

**Fission products** In addition to heat, fission produces hundreds of radioactive isotopes from the original uranium. These emit harmful radiation, and have half-lives ranging from a few seconds to 24,400 years.

**Transuranics** Produced from uranium by its absorption of neutrons, their half-lives are much longer than those of most fission products. After 800 years, fission products have diminished and decayed, and transuranics then become the main biological hazards from uranium fission. They decay through a long series of daughter products, many of which are more dangerous than the original transuranics themselves. The transuranics and their daughters remain one thousand times more toxic than uranium for most of four million years.

**Half-life** A measure of radioactive decay. It is the period of time it takes for a radioactive element to be reduced by a half. For example, the half-life of strontium-90 is 28 years. Starting with one pound (lb) of strontium-90, in 28 years there will be 0.5 lb of radioactive materials; in 28 more years there will be 1/4 lb of radioactive materials; in a further 28 years (84 years altogether) there will be 1/8 lb of radioactive materials left.

**Rad** (radiation absorbed dose) A measure of radiation absorbed by a target (may be a person or a body organ) expressed as the amount of energy transferred to a cell as a result of radiation.

**Radioactive element** One whose atoms can spontaneously eject, or "radiate" particles or energy waves from their nuclei.

**Rem** (roentgen equivalent man) A measure of exposure to radiation. A rem is the number of rads absorbed by a target multiplied by the relative biological effectiveness of the particular type of radiation involved (alpha, beta or gamma radiation). Low level radiation is measured in millirems (one thousand of a rem).

**Alpha radiation** One of the forms of radiation, in which alpha particles are ejected from a radioactive element. Alpha particles, because of their relatively great weight and size, can be stopped by a sheet of paper (or skin), tend to lose momentum quickly, and can penetrate only short distances into matter. However, they are also very energectic, and if moving fast enough when they come into contact with living body cells, they can burst through cell walls and do serious damage to the interior. Alpha particles cause most biological damage when they are ingested, into the lungs or digestive tract, rather than when the skin is irradiated.

**Beta radiation** One of the forms of radiation, in which beta particles are ejected from a radioactive element. Beta particles are about 2000 times smaller than alpha particles, and can penetrate much further through a number of body cells before they are brought to a halt. Again, beta particles cause most biological damage when they are ingested, into the lungs or digestive tract, rather than when the skin is irradiated.

**Gamma radiation** One of the forms of radiation, in which electromagnetic energy waves, rather than particles, are emitted from a radioactive element. These have the greatest penetrating power of any of the forms of radiation. They can easily penetrate skin and other defences; similar to X-rays.

After the Pokhran blast in 1974, Canada stopped all nuclear aid to India, reneging on its commitment to supply heavy water for the second reactor at Kota which sat idle for many months after completion. The heavy water finally came from the USSR, which insisted on even more stringent safeguards than Canada. 'India Today' reported that the start up of MAPS I was also delayed several months because of the shortage of heavy water. Each of these reactors needs about 250 tonnes of heavy water to start up. At the moment, it looks as if the commissioning of MAPS II will also be delayed, if the plant has to wait for indigenously produced heavy water.

The performance of the nuclear power station has also been poor — the worst being that of RAPS I. In four out of six years between 1974-75 and 1979-80, the plant load factor was less than 40 per cent. In March 1982, the plant shut down after cracks were discovered in the end shields and has not started up since. The AEC has repeatedly denied press reports that the plant will be abandoned. The report of the N.B. Prasad Committee set up to look into its problems has never been made public.

The AEC argues that the delays and snags in its projects, inevitable during the learning phase, is now a thing of the past. The performance of MAPS I since it went into commercial operation—65 per cent load factor in just six months—and of the Tuticorin heavy water plant are produced as proof. Few design changes are now foreseen for future atomic power stations which can therefore be rapidly duplicated to set up new ones. In an article written to counter press criticism, Srinivasan said: "Even the Canadians had a very harrowing time in learning how to make large quantities of heavy water and in fact they rebuilt one of their plants three times over ....... We have gone through a very difficult learning process in this technology ..... now fortunately we are at a point where we can confidently expect these plants to be put up and made to work."

**Existing and proposed capacity additions to nuclear power (mw)**

| Year | Size | Location |
|---|---|---|
| 1969 | 2 x 210 | Tarapur I & II |
| 1973 | 220 | Rajasthan I |
| 1980 | 220 | Rajasthan II |
| 1983 | 235 | Madras I |
| 1985-86 | 235 | Madras II |
| 1987-88 | 235 | Narora I |
| 1988-89 | 235 | Narora II |
| 1990-91 | 235 | Kakrapar I |
| 1991-92 | 235 | Kakrapar II |
| 1991-92 | 235 | Location unknown |
| 1992-96 | 11 x 235 | Locations unknown |
| 2000-01 | 500 | Prototype Fast Breeder Reactor, Kalpakkam |
|  | 9590 |  |

But not everybody believes this. K.C. Pant, a former minister of energy and chairman of the Advisory Board on Energy, set up by the Prime Minister to chalk out a long-term energy policy for the country, has expressed serious doubts about the AEC and its targets. Pant is particularly worried about shortfalls in heavy water production and believes that the AEC will not be able to prove itself in heavy water technology before the early 1990s, expecially because it is now moving to larger heavy water plants. The Manuguru plant, for instance, is only a larger version of the Kota plant, which has yet to prove itself. The Thal plant is a larger version of the Baroda/Tuticorin plants, which the DAE is reportedly designing itself. Proven proficiency in heavy water production should be a prerequisite for any major and independent nuclear power programme.

However, so powerful is the AEC and so obsessed by the need to catch up with the West, that any criticism is unlikely to make much of a difference. The atomic energy establishment in India will apparently be restrained only by the load of its own grandiose dreams.

### Anti Matter

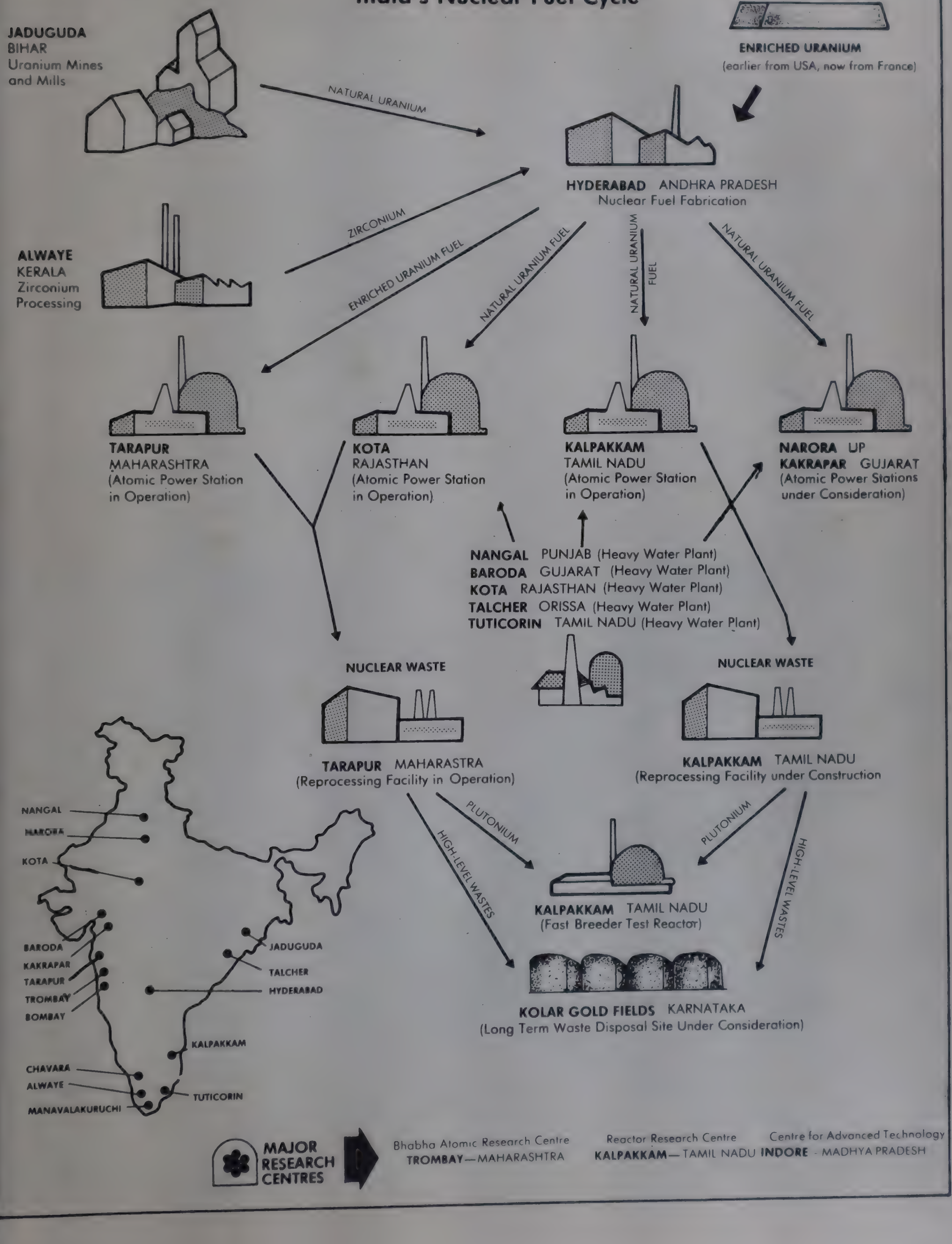
It is the first time in India that citizen's groups have got together to protest against the siting of a nuclear power plant. Kerala's religious and intellectual elite have sent a memorandum to the Prime Minister against the proposal to set up a 2,000 MW nuclear power station at Bhoothathankettu on the northern bank of the Periyar near Kothamangalam. The signatories include such well-known people as former supreme court justice V.R. Krishna Iyer, former governor K.C. Abraham, writer T. Sivasankara and Archbishop Benedict Mar Gregorios. The campaign is being organised by the newly formed Organisation for Protection from Nuclear Radiation (OPNR) which is supported by, among others,the Kerala Sastra Sahitya Parishad, the local unit of the Gandhi Peace Foundation and the Society for Conservation of Nature.

The movement was sparked off by a chance report that appeared in a Malayalam newspaper two years ago about two sites near the Bhoothathankettu barrage on the Periyar. No firm decision has been taken to site a nuclear plant there and an Atomic Energy Commission (AEC) team has only identified it as a possible site. But OPNR workers claim that the right time to campaign against the project is before it is cleared by the government and not afterwards.

The main objection is the state's high population density: 654 per sq km as compared to 220 per sq km for India. An accepted practice is to establish nuclear plants at a site at least 16 km away from the nearest population centre of 10,000 in the main wind direction. In this particular case the municipal towns of Kothamangalam (33,111 people) and Muvattupuzha (25,310 people) are only 8 km and 13 km away. Professor M.P. Varghese, one of the founders of an engineering college at Kothamangalam and of OPNR, argues that the danger to the people and the environment from radiation during the normal working of the plant or from a possible accident would be far greater in Kerala than in less densely populated areas. It is also argued that the natural background radiation is already very high in Kerala because of the large deposits of thorium sands along its coast. In fact, the death rate from cancer is reported to be 15 times higher than in any other state.

Kerala Electricity Minister R. Balakrishna Pillai — who is also a strong protagonist of the Silent Valley project — dismisses as "absurd" the demand that Kerala should not ask for a nuclear power station. He is keen to have a nuclear plant as hydel plants have ceased to be dependable after the unprecedented drought in Kerala in 1982-83.

## India's Nuclear Fuel Cycle


JADUGUDA
BIHAR
Uranium Mines
and Mills
ENRICHED URANIUM
(earlier from USA, now from France)
NATURAL URANIUM
HYDERABAD ANDHRA PRADESH
Nuclear Fuel Fabrication
ALWAYE
KERALA
Zirconium
Processing
ZIRCONIUM
ENRICHED URANIUM FUEL
NATURAL URANIUM FUEL
NATURAL URANIUM FUEL
NATURAL URANIUM FUEL
TARAPUR
MAHARASHTRA
(Atomic Power Station
in Operation)
KOTA
RAJASTHAN
(Atomic Power Station
in Operation)
KALPAKKAM
TAMIL NADU
(Atomic Power Station
in Operation)
NARORA UP
KAKRAPAR GUJARAT
(Atomic Power Stations
under Consideration)
NANGAL PUNJAB (Heavy Water Plant)
BARODA GUJARAT (Heavy Water Plant)
KOTA RAJASTHAN (Heavy Water Plant)
TALCHER ORISSA (Heavy Water Plant)
TUTICORIN TAMIL NADU (Heavy Water Plant)
NUCLEAR WASTE
TARAPUR MAHARASTRA
(Reprocessing Facility in Operation)
NUCLEAR WASTE
KALPAKKAM TAMIL NADU
(Reprocessing Facility under Construction
PLUTONIUM
PLUTONIUM
HIGH-LEVEL WASTES
HIGH-LEVEL WASTES
KALPAKKAM TAMIL NADU
(Fast Breeder Test Reactor)
KOLAR GOLD FIELDS KARNATAKA
(Long Term Waste Disposal Site Under Consideration)
NANGAL
NARORA
KOTA
BARODA
KAKRAPAR
TARAPUR
TROMBAY
BOMBAY
JADUGUDA
TALCHER
HYDERABAD
KALPAKKAM
CHAVARA
ALWAYE
MANAVALAKURUCHI
TUTICORIN
MAJOR
RESEARCH
CENTRES
Bhabha Atomic Research Centre
TROMBAY—MAHARASHTRA
Reactor Research Centre
KALPAKKAM—TAMIL NADU
Centre for Advanced Technology
INDORE - MADHYA PRADESH

## Environmental costs

The nuclear dream, of generating limitless quantities of reliable, clean, safe and cheap power from atomic fission, lies all but shattered in India. The acute crisis of the official nuclear programme is the most important development of the last decade in the energy sector. Every single project undertaken by the Department of Atomic Energy (DAE) has been an environmental liability. Each of the targets set by the DAE has proved elusive, project schedule mauled out of shape, and budgeted costs uncontrollably overrun.

Evidently, something is seriously wrong. The Atomic Energy Commission (AEC) — the policy-making body of the Government of India for nuclear energy — denies this vehemently. For the AEC, the problems are minor and temporary and will be overcome.

Despite such a courageous stand, there can be little doubt that India's nuclear programme is in deep trouble. To understand the depth of the quagmire, it is necessary to look at the most famous of all Indian nuclear power plants: Tarapur.

## India's kamadhenu

On May 9, 1983, 'The Times of India' carried a front page report which claimed that workers at the Tarapur Atomic Power Station (TAPS), had been subjected to radiation exposures much in excess of the permissible levels. The report claimed that the Tarapur plant had broken "several world records" in radioactive pollution and exposed more than 300 men to doses exceeding the 5 rems limit.

On May 12, Homi Sethna, then chairman of AEC, called a press conference. He did not deny the substance of the report or the specific details of exposure mentioned in it; but claimed that the doses of gamma radiation received by TAPS workers were not "harmful". At the end of a two-and-a-half-hour discussion, Sethna conceded the demand of journalists that workers' radiation exposure records be opened to the press, provided "no damage suits are brought against the DAE by the affected workers on the basis of that evidence".

Tarapur is undoubtedly India's best nuclear plant, generating electricity at less than half the cost incurred at the two other stations: the Rajasthan Atomic Power Station (RAPS) at Kota and the Madras Atomic Power Station (MAPS) near Madras. Tarapur generates power more or less regularly, although its capacity utilisation has rarely exceeded 50 per cent, unlike its counterpart in Rajasthan, which is, to put it mildly, not very regular. Also, Tarapur was completed more or less in time: RAPS-I was delayed by four years, RAPS-II by eight and MAPS-I by about 10. MAPS-II has already stretched the schedule by eight years.

But this jewel of the Indian nuclear crown is also the world's worst performing nuclear station. It is estimated to be the most polluted atomic power plant in the world. Until all other reactors of similar design and vintage closed down, it generated between 25 per cent and 45 per cent less power — per unit of generating capacity — than them. Its cost in rupees per watt was the highest among this tribe. Tarapur also has the distinction of being the smallest and hence the

**An inside view of the Tarapur Atomic Power Station — one of most contaminated nuclear stations in the world. (GOI)**

most expensive of reactors — per unit of capacity installed — built for or supplied to any Third World country by the US. It remains one of the most poorly engineered reactors traded anywhere. The toll it extracts from its workers, measured in total human-rems, is the highest known anywhere in the world in relation both to its wattage and energy generation.

Tarapur is thus both asset and liability. For the DAE, it is a demonstrable example that nuclear energy can be put to sustained work. For the plant's engineers, Tarapur is a morass of technical problems. For its workers, it is an unending purgatory of radiation. For the US government, it is a handle to keep India under continuous pressure to sign the non-proliferation treaty and agree not to reprocess the spent fuel.

For the nuclear industry of western Europe, now desperate for orders, Tarapur may turn out to be a boon. According to well-documented reports West German companies are eager to hawk sub-systems of the scrapped Gundreommingen reactor, also of Tarapur's lineage, to the DAE as spares; the French are equally keen on exploring nuclear export possibilities. Evidently what is patently unsafe and dangerous in Europe — KRB Gundroemmingen was scrapped in 1980 for safety reasons — is perfectly safe for India.

The Tarapur Atomic Power Station was designed and built by a General Electric subsidiary, and represented a momentous development both in India and internationally. The two boiling water reactors each of 190 mw capacity were part of a deal signed in 1963 by Homi Bhabha with the US government and financed by USAID.

But by accepting Tarapur as a turnkey job executed by General Electric and its contractor Bechtel, the DAE missed the opportunity of acquiring familiarity with the tasks of designing, detailed engineering, construction, testing and commissioning of a power reactor. This was to leave a vital gap in the DAE's ability to cope with the problems that began to flood TAPS, soon after it commenced commercial power generation in 1969.

**External radiation overexposures at Tarapur**

| Year | No. of workers exposed to more than 5 rems | Maximum individual dose (rems) |
|---|---|---|
| 1974 | 51 | 6.36 |
| 1975 | 190 | 6.27 |
| 1976 | 32 | 18.24 |
| 1977 | 16 | 16.19 |

Source: David Hart, Nuclear Power in India:
A comparative Analysis, George Allen and Unwin, London, 1983

The first of its problems, the switchyard, delayed TAPS's operation on base-load — a capacity factor of 80 per cent or above, the minimal "design level" — by more than a year. When it did reach the level, in December 1970, it operated at that for precisely four months. That was also the last occasion it operated at the rated level for any stretch of time. By April 1971 one reactor was in trouble. The other was operated far beyond the normal schedule for the first run and developed serious trouble. On inspection, both reactors showed high rates of fuel failure.

### Hot reactor

When a fuel bundle fails, the zircaloy cladding develops leaks and the highly radioactive nuclear fuel waste spills into the coolant tubes. This creates high radioactivity regions — "hot" regions — within the reactor and as the radioactive material also spreads into the coolant circuits, their tubes and valves, and finally to the steam generators, condensers and turbines, the entire power station is quickly contaminated. Fuel failure rates have been as high as 20 per cent or even 35 per cent at TAPS — the "design level" being

### Dangerous Deposits

Uranium is mined as an ore usually containing over 0.1 per cent of uranium oxide. Some 3.4 lakh tonnes of the ore are required to generate 1000 mw of power each year in light water reactors of the Tarapur type.

The most significant radiological hazard in uranium mining is represented by radon and its decay products. Inhalation of radon gas and its decay products in uranium mines irradiates the lungs and respiratory tract. This is known to increase the incidence of cancer among miners. A Canadian study of uranium mining in a number of different environments shows that low-level radiation from various sources, including radon, combined with smoking, dust exposure and age, sharply increases the chances of lung and other cancers. As many as 16 out of every 100 miners have a high probability of dying from cancer if they smoke, despite precautions.

India's exploitable uranium deposits are located primarily in the Singhbhum region of Bihar. The generally poor health of Indian miners, the low nutritional conditions prevalent in the backward region of Jaduguda, suggest that the harm caused by uranium mining to DAE personnel in Jaduguda is likely to be much greater. Not even a quarter of all DAE uranium miners in Bihar and Madhya Pradesh wear dosimeter badges. Most of them do not use protective or shielding equipment.

The DAE has been undertaking a good deal of exploratory and developmental drilling in various parts of the country approximately 50,000 metres a year of the former, with some deep-drilling in Madhya Pradesh and Himachal Pradesh. Most of this work is done by contract workers who are not warned of the possible risk from radon, radium and other toxins.

The effect on the environment of uranium mining and milling in Bihar is not inconsiderable. In the Jaduguda uranium mill, the ore is processed mechanically and chemically (acid leaching) to extract the bulk of the uranium content to yield a concentrate of oxides called yellowcake. The mill tailings are dumped into a 25 hectare pond. A 1000 mw capacity nuclear programme annually produces about 3.25 lakh tonnes of mine tailings. The tailings are decanted and the fluid is channelled into a nearby nullah. To this is also added the discharge from the mine. The mine water contains uranium, radium and manganese.

The effluent 50 metres downstream from the tailings pile contains radium, manganese and sulphate above the derived water concentration. By the time the effluents reach the Subarnarekha river, the uranium and radium concentrations in the aquatic system have both increased, the former by 2.5 times to 3.2 mg/cum. To this are added radioactive tailings from a nearby copper plant.

Even at sites 10 km away from the plant, grass and milk samples show the presence of radium which has entered the aquatic system. The slurry collected in the tailings ponds has occasionally flowed into the nullah, compounding the problem. According to DAE health physicists stationed at Jaduguda, most of these recorded levels of concentration are below permissible limits. But the occasional discharge of the tailing slurry from the pond directly into the aquatic system shows how precariously balanced is the entire effluent treatment and discharge arrangement.

**External radiation exposure to workers at Indian atomic power stations[1]**

| | Tarapur (2x210 mw) | | | Rajasthan-I (220 mw) | | |
|---|---|---|---|---|---|---|
| Year | Total no. of workers exposed | No of temporary workers | Total dose (human-rem) | No of workers exposed | Total dose (human-rem) | Human-rems/ megawatt-year |
| 1969 | 399 | — | 43 | — | — | — |
| 1970 | 550 | — | 153 | — | — | — |
| 1971 | 622 | — | 444 | — | — | — |
| 1972 | 1503 | — | 2455 | — | — | — |
| 1973 | 1883 | — | 2733 | 400 | 162 | 4.7 |
| 1974 | 2233 | 1624 | 3278 | 414 | 364 | 5.0 |
| 1975 | 2887 | 2198 | 4244 | 1065 | 761 | 11.5 |
| 1976 | 3140 | 2465 | 4501 | 976 | 788 | 8.9 |
| 1977 | 3600 | 2811 | 4936 | 627 | 279 | 5.3 |
| 1978 | — | — | 4874 | 1018 | 622 | 33.8 |

Note: (1) The above figures indicate only external radiation exposure to workers and internal radiation exposure from ingested or inhaled particles. The DAE has estimated that 10 per cent of annual radiation exposure at TAPS would be due to internal exposure. Experience with CANDUs in Canada has shown that internal contamination with tritium represents 25-30 per cent of total radiation exposure. The above figures for RAPS-I should be increased accordingly to give a true picture.

Source: David Hart, Nuclear Power in India: A comparative Analysis, George Allen and Unwin, London, 1983

well under 10 per cent.

Fuel failure is not the sole problem at TAPS. The station bristles with problems: steam generater tube leaks, recirculation pump failures, control valve leaks, failure of control rod drives (needed to regulate and shut down the reactor), numerous cracks in system piping, extensive corrosion, leaking condenser tubes, and low vaccum in condenser, large leaks in primary to secondary water line, in-core high flux, feedwater pump failures and — very important — numerous failures of the electronic monitoring and control systems, and of instrumentation. One of the most intractable but chronic problems generic to boiling water reactors such as TAPS, is "intergranular stress corrosion cracking": dozens of steam pipes, elbow joints, valves and welds are affected by this. Leaks, with potentially dangerous consequences, are inevitable in TAPS.

Both Tarapur reactors have long been effectively "derated" because of serious design defects, operational problems and high levels of radioactivity in the station. This derating is the real reason for low output for the last four years.

The extensive radioactive contamination has made maintenance and operation of the station extremely difficult as well as expensive — TAPS engineers are at the end of their tether and the 'Technical Specifications' handbook/manual provided by General Electric had within a few years of start-up proved grossly inadequate in tackling most of the major problems.

The result was a spate of "unusual occurrences" — nuclear newspeak for failures, emergencies and accidents. There were as many as 38 of these in the first five years of commercial power generation. By 1980, their number had reached an astounding 344. The bulk of these "occurrences" have not been on account of external causes or procedural/human failures. As many as 254 or 74 per cent were due to "equipment or design deficiency". Of these, as many as 128 or more than half, arose in the reactors themselves. Currently an average of five such "unusual occurrences" take place every month at Tarapur.

Here is an instance from 1980 of an unusual occurrence in unit I; as an International Atomic Energy Agency publication puts it, "Cracks on SS-304, 8-inch diameter emergency condenser steam line and 6-inch diameter reactor recirculation bypass line were observed due to intergranular stress corrosion cracking (IGSCC) and repaired. Repair of the reactor recirculation bypass line leak involved use of freeze plug technique for isolation."

What had happened was that weld joints on the reactor recirculation loop bypass line showed defects after most of the refuelling work in unit I was completed in mid February 1980. This led to the extension of the outage by almost two months to repair the weld joints, a job carried out by using the "freeze plug technique" of isolation of the relevant portions of the line. The engineers chose this method rather than the normal one of unloading the entire reactor core, apparently because the spent fuel water pool in which the core would temporarily be stored had no room for it.

A report in 'Sunday' in 1980 says: "A routine hydraulic check for the primary coolant tube of the Tarapur nuclear reactor around the first week of March soon precipitated a major crisis. A core meltdown was not just a theoretical possibility — the horrors of the Three Mile Island crisis loomed large in the reactor halls, matched only by the vivid images of the 'China Syndrome'. A small crack (pin hole) was detected in the coolant tube. An immediate solution was to remove the two-feet long cracked tube and weld in a new piece of pipe.

"To do this, however, is not easy. The primary coolant tube carried hot radioactive water from the reactor core and a small crack is enough to drain out sufficient radioactive water contaminating the area in a flash of a second. Slow but steady leakage would invariably lead to a fall in the water level of the reactor core, causing the temperature of the core to shoot up relentlessly. This would bring up the temperature to an awesome several thousand degrees — the fission energy pumping up the temperature even further. A core meltdown would then become inevitable. The standard procedure to check the outpour of hot radioactive water is to seal off the tube for a short while and weld in the crack. The sealing in Tarapur was done by using an "ice plug" of liquid nitrogen, penetrating deep inside the tube, hopefully withholding the pressure of water for a ufficiently long time.

“The ‘accident’ on March 14 at 8 am occurred when the ce plug’ did not remain inside the coolant tube long nough and was pushed out by the gushing water, after the ad pipe was cut out and before the new pipe was welded n. A temporary plug of a sort was then somehow pushed in nd held in position by chains. The gush was controlled but he trickle wasn’t.

“In the initial gush an awful lot of hot radioactive water ame out on the hall floor, causing panic and hysteria. The evel of water in the core by that time had already gone own, and this was the moment when all hell broke loose. y the time the gush was controlled by plugs chained inside he tube the place was reeking with activity, at the same ime threatening the core to gallop to a fission hot emperature.

“A routine check, some careless decisions, mistiming, ack of precision, a slightly longer delay than allowed by a eactor handbook, within minutes, can transform a simple outine job to a nerve shattering, horrifying crisis, the nagnitude of which, frankly, has no precedence yet.”

### **emporary workers**

The DAE got hold of unskilled and illiterate labourers from a nearby village, and made them get into the highly radioactive water in order to retrieve the plug. No one knows what radioactivity doses the men received but it is reasonable to conclude that they must have been very high.

The AEC chairperson did not deny the main contentions of the report quoted earlier but claimed that the leak in question was of “pin-hole” dimensions and of marginal significance.

This was the not first time that TAPS had used untrained persons to work in highly radioactive areas. Till the end of 1982, a cumulative total of 10,806 “temporary workers” had been used in the power station to do jobs in areas with high radioactivity fields. They received a cumulative dose of over 1,928 rems. The number of such persons working in the plant at any given time, and particularly during maintenance shutdowns, is usually between 100 and 300. On an annual basis, their number has risen from less than 250 during the first few years of TAPS operation to between 1,000 and 1,500 currently.

The DAE management has claimed that it is not an unusual practice in the world nuclear industry to use contract workers to execute maintenance jobs; and, at any rate, that all such workers are given adequate training in “mock-up” facilities (simulated work environments) before they enter a radiation-infested zone. This, as all those who have interviewed the temporary or contract workers record, is untrue. The vast majority of the concerned workers have not the slightest idea of the harm that radiation can cause. Many cannot even comprehend the language in which instructions are given to them, and there is no such thing as systematic mock-up training at TAPS.

In fact, a recent DAE document submitted to the Planning Commission mentions the need for such training because it is absent: “Another significant development work that has to be initiated to ensure the smooth and satisfactory operation of nuclear power stations is the setting up of the necessary mock-up facilities and training of personnel to do certain complex operations and maintenance jobs in nuclear power stations. This is needed because of the fact that the operating personnel doing any job for the first time ... will take more time and in the process get exposed to a certain amount of radiation ...”

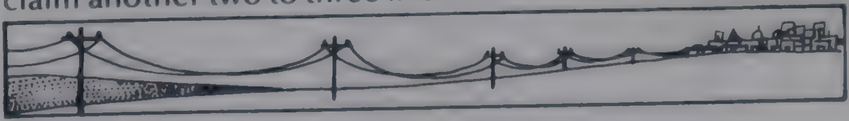
The radiation levels at TAPS are frightening. For instance, near the elevator, at a height of 200 ft, the design value of the radiation field is one millirem/hour; in practice the field is 6 millirem to 8 millirem/hour. This is not all. Heat exchangers in both units deliver on contact a dose of 10,000 millirems to 12,000 millirems an hour. There are many “hot spots” near the steam generators, and in the drywell which the workers need to reach, where the field is in excess of 1000 rads an hour. The workers will receive a fatal or quasi-fatal dose here in a matter of minutes.

The DAE management has over the years become unconcerned about safety. The total human-rem exposure has increased from an average of under 500 rems a year in the first three years of TAPS’s life to about 5,000 rems a year currently. The average dose of the TAPS employee has increased from 117 millirems in 1969, through 359 millirems in 1970 and 2,990 millirems in 1974 to a frightening 4,069 millirems in 1982 — a 35-fold increase in 13 years.

For TAPS maintenance staff, the average exposure was an even more alarming 4.5 rems in 1982. Evidently the strategy of the TAPS management has been to saturate the workers with radiation doses just under the 5 rems maximum, but to distribute doses in such a way that few of them exceed the limit. In the past, overexposures of certain individual workers — 6.4 rems in 1972, 5.1 rems in 1973, 6.1 rems in 1974, 7 rems in 1976, 16 rems in 1977, 11.3 rems in 1978 and 5.1 rems in 1979 — had raised a furore and created much restiveness among the workers.

As part of this strategy, the management has also expanded the base of radiation-exposure while increasing the dose. Thus, the number of TAPS employees charged with “radiation duties” has risen from under 200 to between 800 and 900. The management has also doubled its annual intake of workers from other DAE units (excluding TAPS) to 1,100 to 1,400 over the past decade. During this period the gross energy output from TAPS has actually declined.

Till the end of 1982 TAPS had delivered a total cumulative dose of 45,163 rems. A little over half, 22,921 rems, had been absorbed by TAPS employees, some 13,317 rems by workers from other DAE units and the rest by temporary workers. Following the rough but conservative estimate that 10,000 rems cause about six cancers, radiation in TAPS can be expected to have already claimed 27 cancer victims although the deaths may not have occurred as yet. And for each additional year of operation, delivering a total dose of 4,000 rems to 5,000 rems — probably more as it ages — TAPS will claim another two to three lives.



### **Human-costs**

The human-rem costs of power generation serve as an important criterion for evaluating the desirability of atomic energy. Tarapur’s costs, measured in human-rems per megawatt-year, are probably the highest anywhere in the world. Today they stand at about 100 human-rem per megawatt of capacity. In the US, to take one example, they are roughly 1.2 human-rem/mw. Between 1969 and 1980 the collective dose of workers per reactor rose in the US from 178 human-rems to 791 human-rems or four-fold. In the

## Nuclear Fuel Complex

The Nuclear Fuel Complex (NFC) at Hyderabad is an example of extremely sophisticated metallurgical technology at work, a matter of great pride for the DAE and a symbol of its efforts to attain self-reliance in nuclear technology.

Considering the highly advanced nature of the technology, it is reasonable to expect that equally sophisticated safeguards would be applied to check environmental pollution. But the record of NFC shows otherwise. According to a report published in mid-1984 in 'Deccan Chronicle', the Andhra Pradesh Pollution Control Board (APPCB) has complained to the state government that NFC was polluting the Nacharam industrial estate. The NFC has refused to join the government-sponsored common effluent treatment scheme on the grounds that it has already taken all pollution control measures its own area, investing Rs one crore in handling and processing wastes.

But Hyderabad environmentalists, led by the Joint Forum for Protection of Environment, which includes some of the city's leading scientists, are unconvinced. In a letter to the Prime Minister, the forum requested that "an independent panel of experts and concerned citizens be invited to make an in depth, impartial inquiry".

They have cause for concern. Effluents from the NFC contain high amounts of toxic substances and frequently some waste uranium. In the beginning, these effluents were allowed to flow out to form a pool on either side of an elevated rail track nearby. The pool exists even today with a luxurious growth of water hyacinth on its surface.

Sedimentation tanks to contain these effluents were not built until about five years after the plant began production. The delay has resulted in contamination of the groundwater in neighbouring villages with high levels of nitrate because of water seepage from the pond. Studies carried out at the request of APPCB show that wells in the neighbourhood of NFC contain as high as 96 mg of nitrate per litre against the normal level of 10 mg per litre. Radioactivity levels, too, have risen between six and 20 times over the last 10 years. Even today, effluents flow out when sedimentation tanks are full.

High levels of nitrate in drinking water can cause blood disorders. In neighbouring Mallapuram village abortions have become more frequent, (though the link between pollution from NFC and these abortions has yet to be investigated). Ahmed Ali Khan, a former NFC scientific officer who resigned to set up a small textile shop in Hyderabad told an 'Indian Express' reporter that "radioactive pollution in the NFC area was evident years ago and now it might be reaching dangerous levels".

The NFC has been selling solid nitrate waste from the sedimentation tanks to a private factory called Deccan Nitrates. This company is so callous with the wastes that within a year of beginning production, drinking water in several wells around the Deccan Nitrates site has become undrinkable.

In the last two years, indiscriminate dumping of zirconium scraps by NFC has caused two accidents, in 1980 and in 1982, resulting in the deaths of six persons. Scrap containing zirconium dust is highly combustible, particularly on friction and in the presence of magnesium chloride, and should be disposed off in uninhabited area with stringent precautions. NFC dumps it outside the factory in an open area accessible to anyone.

In the first accident, four lambadi tribals died of burns following an explosion of the scrap. All that the NFC did was to change the dumping ground from a relatively more inhabited area opposite the administration building to a relatively less inhabited area behind the factory. Two years later two children who lived in a nearby hut, died in exactly the same manner while they were playing in the new dumping ground, which is also easily accessible to the public. Following this, the NFC started building a wall around the dumping ground.

The problem of radioactive wastes has haunted all nuclear facilities and the NFC is no exception. About one barrel of low level radioactive waste is being buried within the factory premises a few feet underground every day, packed in plastic packets and sealed in galvanised iron drums. After a few years underground, the drums could corrode leaving the plastic packets exposed to rodents or soil settlement, allowing radioactivity to enter the water system and the food chain.

Significantly, three students in the DAE school near the NFC have contracted cancer. They occurred over a period of three years and many experts consider them to be an abnormal number for a single residential colony. Inside the factory, workers have complained about the high level of various gases like sulphur dioxide, nitrous oxide and chlorine, and many suffer from allergic and respiratory disorders. Safety apparel like face masks and rubber gloves are generally inadequate and unsatisfactory. Medical checkups are done annually but these are general and not meant to detect occupational health problems.

same period, it increased at TAPS from 21.5 human-rems to 2,125 human-rems, almost 100 times.

Tarapur's collective worker dose per reactor is 270 per cent higher than in the US. But the US level is itself too high. Many environmentalists have demanded a reduction in collective doses to 300 human-rems to 500 human-rems per large (1,000 mw) reactor per year. A human-rem budget of 0.5 human-rem/mw for existing reactors and 0.2 human-rem/mw for plants under construction has been proposed by certain researchers.

By these standards, TAPS is 200 to 500 times dirtier and more expensive in human-rem terms than the minimal acceptable hazardous nuclear reactor. Radiation has become inseparable from power generation. The safety techniques on which TAPS is founded are obsolete. The plant was designed and engineered in the early 1960s, well before the two major waves of design changes mandated by regulatory orders appeared in the world nuclear industry: from the late-1960s to the early 1970s, and then in the post Three Mile Island period. These new regulations forced industry, particularly in the US and northern Europe, to improve safety engineering and evaluation standards. In any other country, TAPS would be ordered closed, just like reactors of similar vintage have been scrapped — in spite of records less appalling than that of TAPS. But TAPS still has another 10 years to go, which means another 30 lives sacrificed on the altar of the nuclear god.

## How Safe is "Safe"

Overexposure to radiation is an occupational hazard in the nuclear industry. In India's DAE, it is routine.

The nuclear industry holds that there is such a thing as a safe level of exposure to ionising radiation: five rems a year. If a person does not exceed this level, the threshold, no harm will result.

This theory, recently modified a little to allow for "stochastic" effects — those for which the probability of an effect occurring is regarded as a function of the dose — is the foundation on which the nuclear industry's standards for radiological protection rest.

The DAE's casual attitude even to cases of exposure exceeding its own norms arises from this theory. Most nuclear scientists and engineers tend to believe that radiation is fundamentally harmless (except in very high or semi-fatal doses exceeding 50 or 100 rems). Thus, the "maximum permissible limits" are flexible in practice, and are stretched on the exigencies of nuclear plant operations.

In reality, however, ionising radiation is among the worst of poisons: it produces cancer and irreversible genetic deformities. There is overwhelming evidence to prove that there is no safe level of radiation exposure at all. No dose of radiation is so low that the risk of cancer is zero.

Says Karl Z. Morgan, a founder of the science of health physics and former chairman of the International Commission on Radiological Protection, "there is never a complete repair of the radiation damage, since even at very low exposure levels, there are many thousands of interactions of the radiation with cells of the human body".

The risk of cancer varies from person to person, and differs with the types of cancer, age, sex, genetic inheritance, individual characteristics and eating and smoking habits. Thus, a study has shown that children with allergic diseases (eg asthma) have a 300 per cent to 400 per cent increased risk of dying of leukaemia than other children.

Evidence of the carcinogencity of low level radiation comes from a number of studies. Among the most important of these is the largest ever epidemiological survey of radiation workers, those at the US government's plutonium production plant at Hanford (Washington) made by Thomas Mancuso, Alice Steward and G. Kneale. The study reveals that the incidence of multiple myeloma, a bone marrow cancer, doubled with a cumulative dose of only four rems, a dose lower than the currently specified annual exposure limit. The doubling dose for sensitive cancers — lung, pancreas, large intestine for a person of 40 — was 14 rems to 15 rems. The commonest interval between induction and death was 25 years. Risk of cancer increased with age. Six per cent of all deaths among the 35,000 workers surveyed were attributable to radiation.

Two studies have implicated radioactive fallout as a cause of an increased risk of cancer, primarily leukaemia. One was carried out by investigators at the Centre for Disease Control in Atlanta and it included more than 3100 men who participated in 1957 in a nuclear weapons test code-named "Smoky". Most of the men at the Smoky test were exposed to less than five rads of external radiation, according to the exposures monitored by their film badges. Analysis of the data is not yet complete but so far eight cases of leukaemia have been found. Fewer than four would be expected in a group of men of that size and age range.

The US Environmental Protection Agency (EPA) has reduced recommended exposures for people living near nuclear facilities to 0.025 rem (25 millirem) a year from 0.5 rem (500 millirem). The US Energy Research and Development Administration has recommended an even lower limit for the public — at 0.005 rem (5 millirems) a year.

There is fairly persuasive evidence to show that high natural background radiation is related to genetic damage and cancer. A study conducted by N. Kochupillai and other scientists observed radiation related genetic changes in coastal Kerala, the location of monazite sands, where the background radiation is 1.5 rems to 3 rems per annum, much less than the levels considered safe and acceptable by the nuclear industry.

In spite of stiff resistance, the maximum permissible level of exposure for occupational workers was dropped by a factor of 10 by the International Committee on Radiological Protection between 1934 and 1956 and that for the public by a factor of 300. But it is peculiar that the recommended exposure standards for the public and occupational workers should differ by a factor as high as 10 or, in the US, even 200. It is absurd to presume that a radiation worker is 200 times less susceptible to radiation damage than another member of the population.

## Sentinels of Safety

Advocates of nuclear power have always argued that nuclear power plants are "good neighbours" and completely harmless. In a recent article, the AEC chairperson said: "Since the auto came into existence, it has killed 25 million people in the world . . . geophysical hazards such as floods, droughts and cyclones are estimated to account for an average of 250,000 deaths each year in developing countries . . . As compared to this . . . there has not been a single case of radiation-induced fatality anywhere in the world since the inception of the nuclear power industry."

This argument is not only specious — if aircraft or cars are unsafe, it does not follow that nuclear reactors are safe — but it is also calculated to play down the nature of risks and the consequences of different kinds of hazards. More people have died while crossing the street than have died, say, in chemical warfare. But that cannot be an argument to support the latter.

The nuclear safety problem is too complex to be solved by merely setting up a body of experts, not directly under the control of the nuclear industry or committed to its power programme. Nevertheless, an independent regulatory body, which licenses nuclear facilities, sets its own safety standards for the design, construction, operation and maintenance of Nuclear facilities, and which is empowered to veto the operation of facilities, will certainly be an advance over a safety monitoring group that is controlled by the nuclear establishment. Such progress albeit often formal, has been registered in most western countries.

In India, it was the Health Physics Group of BARC, a part of DAE that would oversee the safety aspects of nuclear plants until recently. In 1980, the Committee on Power headed by former Planning Commission member, V.G. Rajadhyaksha strongly recommended that "there should be an independent body, outside the Department of Atomic Energy, to lay down and monitor observance of minimum standards for siting, design, construction, operation, maintenance and safety of nuclear power plants on the lines of the Nuclear Regulatory Commission (in the US)."

Accepting this recommendation, the government has set up an Atomic Energy Regulatory Board (AERB) and its chairperson Professor A.K. De, after visiting RAPS-I made a strong statement in mid-1984: " . . .we will not compromise on safety. Once we find that the leak cannot be plugged, we will shut down the plant."

But the organisation still lacks public credibility as it remains a part of AEC. G.D. Khera, secretary of the BARC Officers' Association (BARCOA) in a letter to the 'Times of India' said that the AERB "is essentially a toothless organisation." Even the Advisory Board on Energy set up by the Prime Minister has recommended to her that to build up public confidence in the organisation, it must be completely independent and distinct from the AEC and its reports should be presented directly to Parliament.

The DAE is, however, not convinced. It believes that the current structure in which the AERB reports to the AEC, which in turn reports to the Prime Minister is adequate. Morever, it argues, the the AEC itself is open to scrutiny by a consultative committee of the Parliament.

## Rajasthan's agony

Because Tarapur grabs so many headlines, the Rajasthan Atomic Power Station (RAPS) has rarely received adequate attention. Which is a pity, as RAPS performance is by no means unremarkable. For a station that has worked at about a third of its rated capacity, RAPS has no equal in the rest of the world as far as health hazards go. It is the worst performing reactor of the CANDU type. While the CANDU tribe's cumulative load factor has been about 60 per cent or 65 per cent — and even higher during the peak period — there is no hope that RAPS will reach even two-thirds of that.

One simple reason for this is that the reactor in unit I at RAPS-I has had to be shut down 251 times during its 10-year life-span, or roughly once every fortnight. The reactor has just started up again after more than a year's shutdown. Cracks had been found in the end-shield, a crucial part of the reactor vessel. RAPS-II has also so far recorded a low capacity factor.

Per megawatt of installed capacity, RAPS generates less energy than any other nuclear plant, new or old, even when compared to other faltering nuclear power stations in the Third World. Even reactors in South Korea and Pakistan produce more electricity per megawatt per year.

The roots of the trouble go straight back to Canada, and its first awkward, attempt at a commercial nuclear power plant, at Douglas Point near Kincardine, Ontario. The $81.5 million 200 mw Douglas Point reactor project was launched in September 1960, to be completed in 1964 and start commercial operation the next year. It started only in late 1966 and its operator, Ontario Hydro, took another two years to overcome operational problems and enter commercial service. Even then, the station operated for only one of its first twelve months.

Douglas Point has had an average capacity factor of under 46 per cent, as against the expected 80 per cent. Power generated at the plant has proved 170 per cent dearer than originally estimated. It has had a questionable safety record. The emergency core cooling system has failed to meet the plant's licensing conditions. According to Canada's Atomic Energy Control Board (AECB), the emergency cooling system at Douglas Point could not prevent fuel failure — which could lead to serious accidents — even if it worked. In 1977, it ordered a "derating" of the plant's power levels to 70 per cent of its capacity, as a safety requirement, and also asked Ontario Hydro to shut the plant down in 1980 to make modifications costing $5 million. Air leakage rates from the plant building were also found to be too high. It is not known if Douglas Point has met with the AECB's approval as yet.

The Douglas Point design is the basis for both RAPS reactors. The Canadians, in fact, built RAPS-I and a good deal of RAPS-II. Rajasthan thus inherits all the major design deficiencies of Douglas Point. But some of them have proved much worse in the Indian station: heavy water leakage, to take one instance, has been five to eight times higher than in the Canadian reactor.

While Douglas Point was completed with a cost overrun of just 4 per cent, the figure for RAPS-I is 76 per cent and for its second unit over 90 per cent. Unit one of the Madras Atomic Power Station, which in all its essential aspects is a replica of the RAPS reactors, has also had a cost overrun exceeding 90 per cent. The construction delays for RAPS II and for MAPS have also been well in excess.

The elongated construction schedules created serious difficulties for RAPS. While half or more of the second unit was complete, and waiting for its initial charge of heavy water, the station management started cannibalising it, lifting whole sub-systems and vital components to serve the first unit. Inventory control went haywire, operational schedules lost their meaning and planning became impossible.

All this told not only on unit II but eventually on the first unit itself. The station management has failed to solve the serious problems that continue to plague RAPS: daily heavy water losses of 60 kg to 80 kg — about Rs 4 lakh a day — turbine failure, malfunctioning of the fuelling machines, leaks in valves and glands, breakdown of pipelines, and

India's latest nuclear station to go on stream — the Madras Atomic Power Station at Kalpakkam. (GOI) most important, metal failure, particularly in the vital coolant channels.

The existence of metal failure was recently acknowledged by M.R. Srinivasan, director of the DAE's power projects engineering division, now rechristened Nuclear Power Board: "We have recently taken out a coolant channel from RAPS-I which should provide us an opportunity for generating vital information. A very important question related to coolant tubes is whether they will require one or two replacements in a 30-year life and whether zirc-niobium is in fact a better material than zircaloy . . .". Similar questions have also been raised about the integrity of carbon steel tube sheets in the end-shields, under irradiation. There is no reason to believe that most of these questions have been settled or solutions found.

The Indian reactors, based on the CANDU design, the cornerstone of this country's nuclear power generation programme, inherit another problem. The pressure tubes (coolant channels that hold the natural uranium fuel pellets in the core) start expanding in length. The allowance made in the design for this elongation is inadequate. This is a major design flaw shared by all CANDU reactors. It can create serious operational problems, causing leaks or high radiation fields, and making on-power refuelling difficult, if not impossible. It may have contributed to the appearance of cracks in RAPS-I's end-shield.

Large numbers of RAPS workers have been exposed to hazards from both ionising radiation and tritium. Tritium, a heavy isotope of hydrogen (atomic weight 3) is a potent toxin that is a by-product of heavy water reactor operation. It is omnipresent in and around RAPS reactors and shows particularly high concentrations in the atmosphere or in light/heavy water whenever there are leaks — these are routine, and can be as high as 2 kg per minute.

Tritium is readily absorbed by the human body. Its presence at several places in RAPS exceeds the maximum permissible concentration levels by several multiples: four, 20, even 500, yet the vast majority of workers in the station are not ordered to use protective clothing or masks. Often they are not even warned of high levels of tritium contamination in specific areas of the plant.

In respect of gamma radiation, the published record of RAPS is equally bad. In 1975 its total collective personnel exposure was "approximately" 800 human-rems — perhaps the highest for any 200 mw reactor in the world, barring, of course, Tarapur. The following year, RAPS personnel received "about 650 human-rems" and contractor personnel 150 human-rems. In 1977, the station personnel received 455 human-rems and there was no entry against the item of "contractor personnel" exposure in the International Atomic Energy Agency IAEA proforma returned by RAPS. In 1978, the total had reached 893 human-rems.

Some of the figures, relating to the earlier years, appear to be a trifle too precise and round, but since 1978 there has been no entry at all in the available IAEA information sheets for radiation exposure at RAPS. This is precisely the period in which the end-shield cracks in unit I must have led to high radiation levels — as well as increased worker exposure because of repair efforts — and during which RAPS-II too came on line to expose its workers to fresh doses of gamma rays.

Contamination at RAPS can only increase with time. Even its present level remains unacceptably high. If a reasonable human-rem ceiling, such as 0.2 human-rem or 0.5 human-rem per megawatt of capacity was imposed on RAPS, the station would have to close down permanently.

### Nuclear Economics

For all the excitement of a ship cruising round the world on a pound of fuel, nuclear fission is an expensive form of producing power. Over the past decade, capital costs of nuclear power have risen rapidly. According to a US estimate, if all the power used by Americans were to cost as much as the electricity generated by nuclear plants scheduled to go into operation in the mid-eighties, the country's electricity bill would rise by 130 per cent.

The Indian experience may not be different. The capital cost of a nuclear power plant with two units of 235 mw in 1983 rupees are, by the DAE's own estimates, about Rs 11,000 per kw of installed capacity. To this should be added the costs of setting up heavy water plants. The initial charge of heavy water per 235 mw reactor is 255 tonnes of heavy water and then 8 tonnes are needed annually to make up for losses. The 110 tonne per year plant at Thal will cost Rs 233 crore and produce heavy water at about Rs 6000 per kg and the 370 tonne per year plant at Manuguru will produce at over Rs 7000 per kg. Even assuming lower costs, it means that each such plant will need at least Rs 300 crore of heavy water to start. And this is assuming that heavy water plants will function properly and at estimated capacity factors. In addition investment will be required in uranium exploration and mining and fuel fabrication facilities.

This nuclear plant will generate power at Rs 0.62 a unit at a capacity factor of 75 per cent or at Rs 0.90 at a factor of 50 per cent. This last may be more realistic. Increases in gestation period and capital costs can also increase the unit cost of nuclear power. According to DAE's own calculation, if the capital cost, were to go up to Rs 730 crore and the gestation period to 12 years, the cost of a unit of power will go up from 62 paise (Rs 530 crore capital cost and 8 years gestation period) to 95 paise. And if on top of that, capacity factor is below 75 per cent, the cost will escalate further. The DAE has included in these costs a decommissioning cost of about Rs 1000 per kw installed—Rs 57 crore for the entire station—which too may be optimistic.

This is only the direct cost of nuclear power. If the indirect costs such as those of reprocessing and waste disposal are added, the picture becomes more complicated. DAE estimates the reprocessing cost at Rs 2500 per kg of spent fuel and waste disposal costs at Rs 1000 per kg of spent fuel reprocessed. But the DAE does not add these costs to the cost of nuclear power because it argues that the value of plutonium obtained from reprocessing spent fuel compensates for these costs.

This is not all. If hidden costs in terms of R&D expenditure incurred to develop the nuclear power programme and the infrastructure, training and personpower costs of the various establishments under the DAE are added, the cost swells further. If all the power generated in India were to be priced at this level, the country's electricity bill would increase substantially.

In recent years, the price of coal and coal power stations has also increased substantially but even then, it is now widely accepted that nuclear power does not have any cost advantage over coal power stations. If India must build nuclear stations, it is to build breeders in the future. A nuclear capacity of 10,000 mw can help to produce plutonium for finally operating thorium-based fast breeders—a system which promises to produce more energy than it consumes, the mythical 'Kamadhenu', as Homi Bhabha called it. But countries across the world, except France, are rethinking the breeder. Should India also put its future in store in the breeder?

## Narora's foundations

The DAE's disregard for human and environmental safety is starkly outlined in its decision to site the country's fourth atomic power station at Narora, in western Uttar Pradesh. Narora is situated in an earthquake-prone, active seismic zone (grade IV), only 50 km from the Bulandshahr epicentre of a 1956 earthquake. The site is in a geologically unstable area, with a "tear fault" close by. Narora is also on the bank of the Ganga and in the midst of a densely populated region. At the precise location where the Narora atomic power project is now being erected, the water table is only 4 m to 5 m below ground level; there is no rock for a stable foundation; even at 300m depth—as against the usual foundation drilling depth of 100 m—no secure, stable geological structure exists.

Who is responsible for choosing the spot? Certainly not the Vengurlekar Committee on site selection, which in its 1972 interim report, had opposed the proposal. A.K. Ganguly, formerly head of BARC's chemical group, has been a vehement critic of the decision. The very top of the DAE hierarchy took the decision.

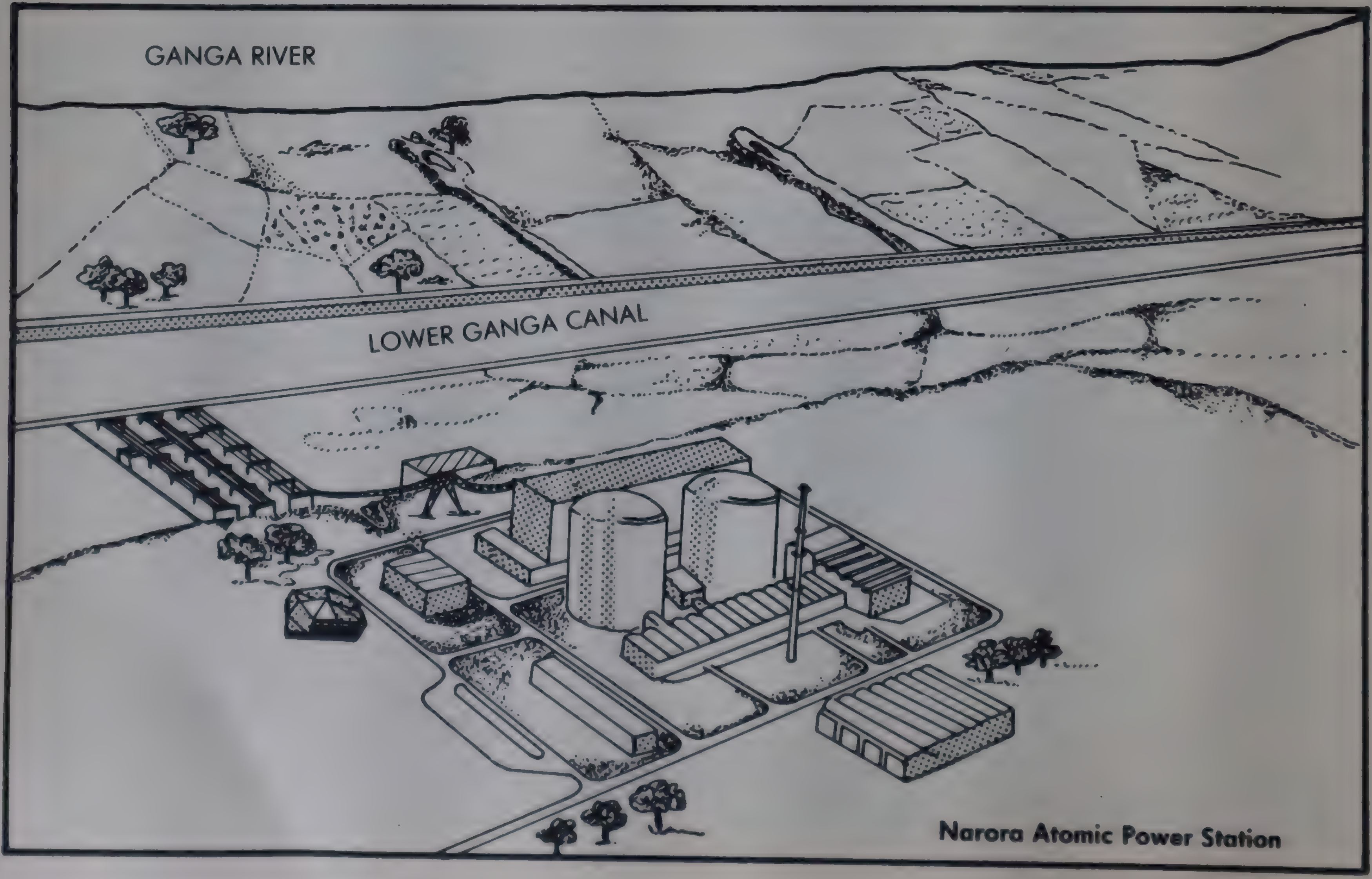
The decision to locate an atomic power project at Narora had its roots in a grandiose scheme, formulated 15 years ago, to set up a series of spectacular "nuclear-agro-industrial" complexes in certain parts of the country to bring about their instant, large-scale, technological, (and hence social) transformation. These "nuplexes" would generate vast quantities of cheap power to run pumpsets, produce fertilisers and drive the wheels of industry. The nuplex scheme was never translated into a plan of action. It was quietly buried. However it survives in the shape of the twin reactors of Narora.

## Nuclear wastes

The Bhabha Atomic Research Centre (BARC) is the prime R&D institution of the DAE. It is also the source of safety standards, the headquarters of its health physics and radiological protection divisions and the cradle of all senior DAE staff. BARC, too, has had a dismal record of radiation exposure. It has subjected—at last count, till eight years ago—four persons to annual doses exceeding 5 rems and has a human-rem cumulative total that runs into at least four digits.

It has also had the distinction of having registered the highest known dose that any DAE employee has received in a single year—22.28 rems. That was more than 10 years ago, and as recorded in figures published seven years ago. Since then, the statistics have dried up but not the propensity of TLD (thermo-luminiscent dosimeter) and film badges to disappear, or be "lost", or to have their film "spoilt". In the absence of the missing quantities of badges—the only permanent record of the individual worker's radiation exposure—no one will ever know the precise toll of human health claimed by BARC.

The worst aspect of this relates to the plutonium plant at Trombay. The plant was dismantled but is now being rebuilt in an expanded form. Besides gamma radiation, the hazard in the plutonium plant is plutonium itself one of the most toxic substances known to humans. An employee who was exposed to this deadly element in 1976, was asked to go into the cell room of the plant and clean solid deposits accumulated in and around the cells—without wearing a gas mask. He swept the cell with a broom. The employee claims that inspite of repeated requests from him no immediate body burden measurement for uranium or any other



Narora Atomic Power Station

substance was made, instead he was given a promotion and the case was hushed up.

It is relevant to note that originally the plutonium plant, designed and built by H.N. Sethna, had never been cleared for safety. For several years it was the most dangerously polluted site in BARC. Reprocessing spent nuclear fuel to recover plutonium is among the most hazardous, problem-ridden and environmentally dangerous parts of the nuclear fuel cycle. No plant built to reprocess spent fuel from reactors has worked for any length of time at even a fifth of its capacity. Four of the world's five large reprocessing plants with any history of operating experience have been closed down, since they were grossly unsafe and accident prone.

Reprocessing has also been a major source of proliferation of nuclear weapons as it represents the less expensive and easier of the two principal routes to the atomic bomb. Reprocessing plants the world over have long been notorious for wide discrepancies between theoretically predicted plutonium yields and actual ones. A great deal of plutonium that ought to be recovered tends mysteriously to disappear. The new reprocessing plant at Tarapur, PREFRE, is no exception to this. Already some 6 kg of plutonium, or roughly the quantity needed to make a bomb, cannot be accounted. The destructive possibilities represented by plutonium reprocessing pale into insignificance when compared with the ultimate and near-permanent hazard of nuclear power: radioactive waste. The problem is one of storing high-level wastes safely over an almost geological time-scale. Not even the most fiercely loyal of nuclear faithfuls claim that the waste disposal problem has been licked.

Up to 20,000 tonnes of this concentrated poison exists in the world today. Most of it is stored at power stations in spent fuel pools—"temporarily" but really for years.

Even if they are vitrified—turned into a kind of glass, as the French and the DAE are trying to do—or stored in special "stable" disposal sites—West Germany is trying to find these—or dumped into the sea, they remain a grave liability, the heaviest that the nuclear business carries. Putting them into salt formations or deposits high up in the mountains will not do, although these are meant to be relatively stable formations.

The problem posed by so-called "low-level wastes" is far from inconsiderable. Their sheer volume runs into billions of cubic feet. The dumping of these wastes—including uranium tailings, fuel fabrication wastes, tonnes of muck discarded by power reactors each year, including contaminated clothing—into shallow trenches or the sea is a major hazard. They are bound to enter the food chain sooner or later.

What would the cost of waste disposal be? There is a whole range of estimates from the 5 per cent to 10 per cent spectrum to the 30 per cent to 60 per cent level—as a proportion of the cost of nuclear power generation. In the US the utilities are charged $ one for every 1,000 mega watt hour (mwh) of electricity generated towards the control cost of waste "disposal". This is considered very inadequate by environmentalists. In India, the direct price has so far been paid in human-rems and human life; the indirect money price is paid by the ordinary taxpayer through the public exchequer.

The decommissioning of old nuclear power plants presents similar economic worries. The term "decommissioning" is a misnomer since it implies a routine shutdown procedure similar to abandoning an old coal mine. But nuclear plants that have been operating for decades have many parts that are radioactive and must be kept shielded from the biosphere for centuries. One approach is called "entombment"—sealing a plant with reinforced concrete and providing guards for an indefinite period. But entombment, though possibly economical, poses unacceptable long-term environmental problems, particularly since some materials would remain radioactive for as long as 100,000 years, long past the useful life of concrete. Ensuring the integrity of human institutions to provide centuries of guard duty is also problematic.

The more likely approach to decommissioning is dismantling each nuclear plant piece by piece, and transporting radioactive materials to suitable waste sites. The technical difficulties involved are considerable. Because of the high levels of radiation that would be encountered, elaborate safeguards must be used to limit human exposure. Some parts of the reactor would have to be dismantled under water in special pools using remote-control torches. Other procedures would have to be done in many shifts to limit the radiation received by individual workers to acceptable levels.

Cost estimates for dismantling a 1,000 mw nuclear plant range from $50 million to over $1 billion (1982 dollars). The largest plant yet dismantled was the tiny 22 mw Elk River plant in Minnesota: the procedure required two years and $6 million, but provided few lessons for dismantling plants 50 times as large and hundreds of times more radioactive. Yet the low costs frequently cited by the nuclear industry are based on the Elk River experience.

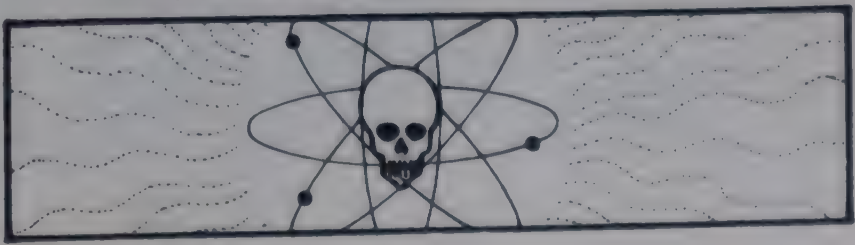
More revealing is the Shippingport plant, scheduled for decommissioning in the mid-eighties at a cost of $60 million to $70 million, according to a contract signed in late 1983. The difficulties that may be involved in decommissioning are illustrated by the clean up of the disabled Three Mile Island plant, which has encountered a wide range of unanticipated problems and will cost well over $ one billion.

The 50 per cent estimate appears fairly reasonable. Decommissioning, like waste disposal, also involves a non-monetary cost—human-rems.

**Estimated nuclear wastes generated every year in India**

| | 1982 | 2000 |
|---|---|---|
| Installed capacity (mw) | 800 | 10000 |
| Primary solid wastes ($m^3$) | 1700 | 107000 |
| Low-level waste concentrates ($m^3$) | 2500 | 77100 |
| Intermediate-level wastes ($m^3$) | 650 | 19900 |
| High-level wastes ($m^3$) | 350 | 8000 |

Source: Sethna, H.N. et al, Waste Management Policy and its Implementation in India, IAEA-CN-43/133, Vienna



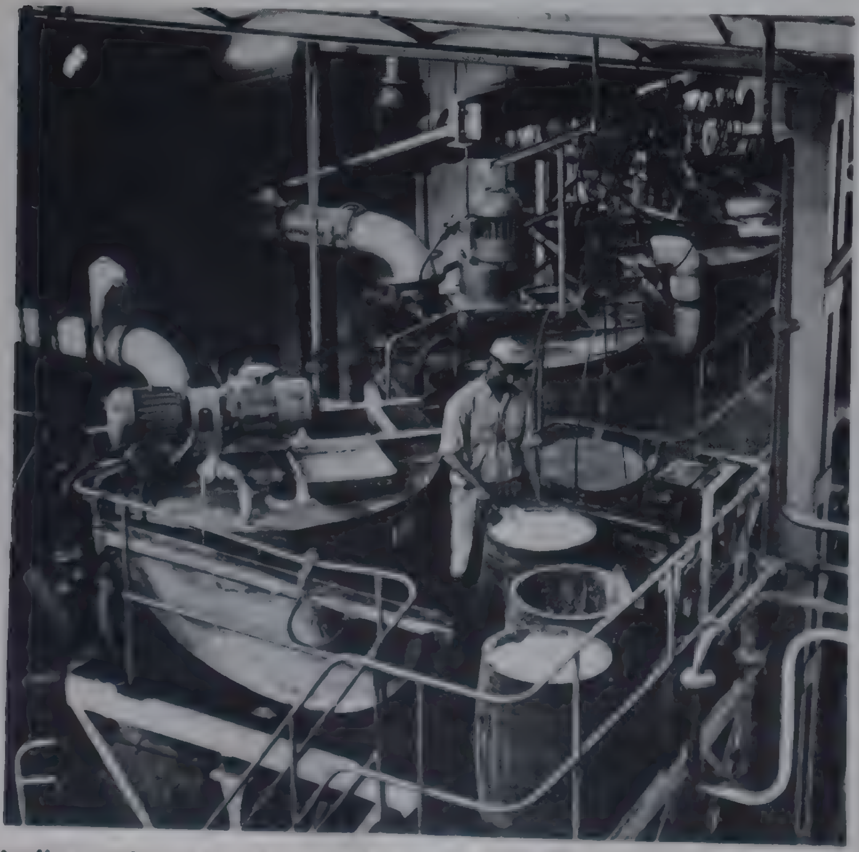
## The grand plan

Homi Bhabha's grand nuclear energy plan, is probably the most comprehensive, ambitious and expensive effort ever launched with the objective of effecting a transformation of Indian society by means of technology. The plan was conceived in the early years of independence and it promised 2 lakh mw of nuclear power and all the ensuing prosperity.

Underlying this plan adopted by the Atomic Energy Commission (AEC) was a whole series of premises, till then untested but nevertheless accepted, that nuclear power involves the quintessential, ultimate technology of the future; that the principal task in the field of energy for a poor developing country like India is, as in the developed world, to generate more and more electricity; that nuclear power is the cheapest means of doing so; and that its success as a technology is directly predicated upon the knowledge provided by the new "science" of the atom; that any technological problems in design, engineering, safety, scaling-up, can be solved; and, therefore, nuclear power is a candidate for a large public resources commitment.

Though India's scientocrats still declare confidently that nuclear power is "inevitable", at least in retrospect, the earlier assumptions appear erroneous. Nuclear engineering is just one of many post-war technologies. It is not half as important in its potential/actual impact as, say, electronics, informatics or, in the future, photovoltaics. It is also not difficult to appreciate that electricity is only one and a somewhat expensive, if versatile, form of commercial energy, which in a poor country can only represent a small, albeit growing, fraction of total energy consumption. The very concept of 'electrification of society', especially one based exclusively on centralised power generation, can be called inadequate for meeting social needs.

Some nuclear proponents in India now concede privately that the high costs of atomic power are no more than the price the country has had to pay for "self-reliance" and for its energy "independence". Delays and high cost overruns are explained as being due to the Canadian walkout following the Pokharan blast and a ganging up by the London Club — the world cartel of nuclear suppliers and exporters — against India.


**India produces thorium fuel at Trombay. Because of limited uranium, the Indian government has plans to build thorium-fuelled fast breeder reactors. (GOI)**

The Canadian walkout has admittedly been a setback. But it was so because, in the first place, the DAE was totally dependent on Canada's AECL for the design, construction and commissioning of the CANDU type reactors. What is worse, this dependence continues. In each one of its essential aspects, the DAE's design for the RAPS, MAPS, Narora and Kakrapar stations — or all of the 10 reactors to which it is committed — is an exact replica of the Canadian Douglas Point plant which, incidentally, is one of the worst performing CANDUs in Canada and the world. In Canada, this design was significantly altered in the next generation of larger Pickering and Bruce reactors.

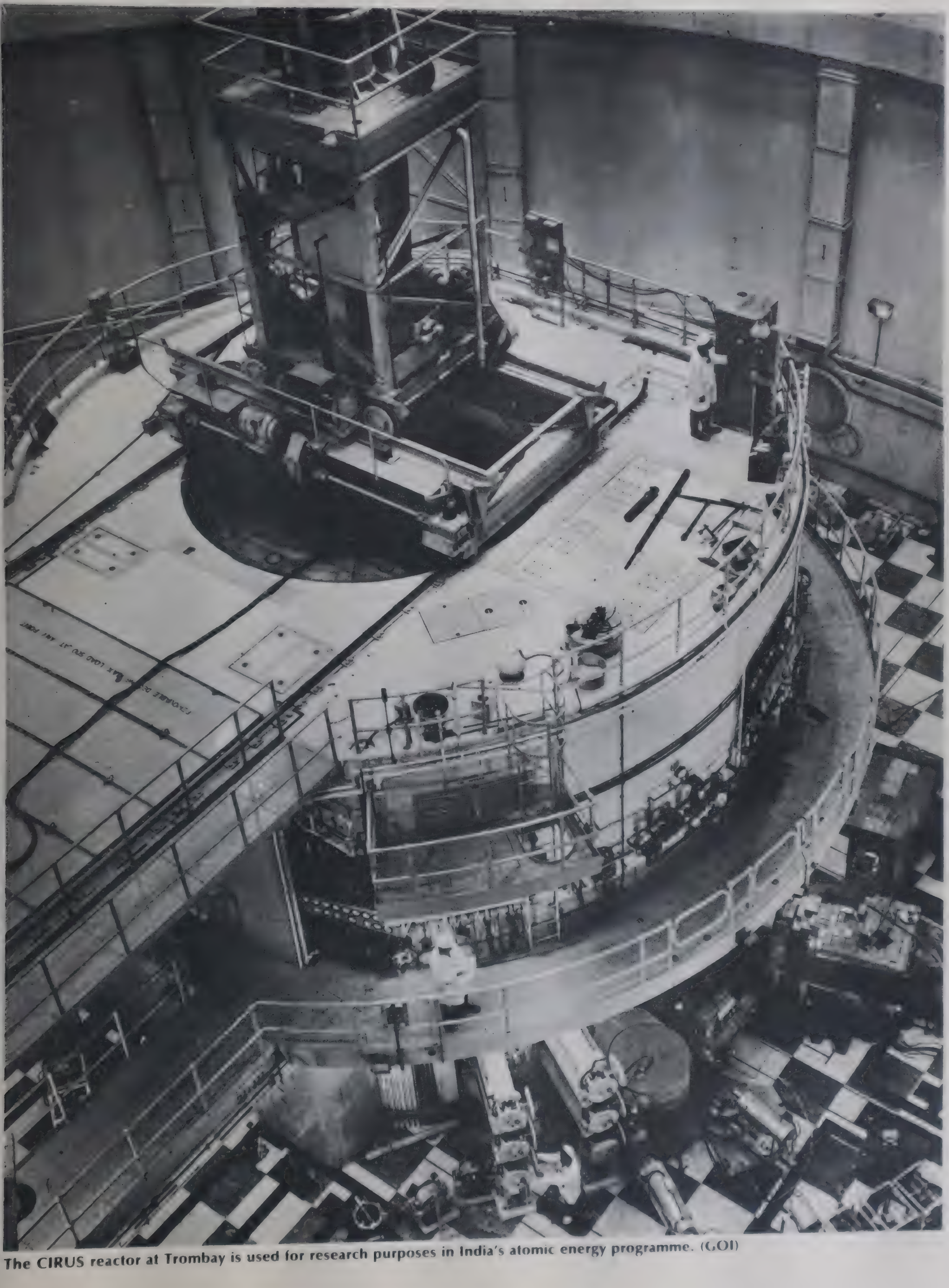
The DAE has not even begun to draw up a detailed design for the 500 mw reactor. Meanwhile, it is veering round to the idea of importing whole reactors and power stations in the 400 mw to 500 mw range, probably from USSR. AEC's Chairperson, Raja Ramanna, justifies this of the grounds that importing a nuclear reactor is no different from importing a coal-fired thermal station.

The "learning effect" has been extremely difficult and weak even in the US, which has had the largest experience with atomic energy, especially on capital and generating costs. Inflation adjusted nuclear costs have tended all over the world to rise, not fall, with time — and due not only to increasingly stringent safety regulations that add millions of rupees to fixed investment each year.

In the US, no new reactors have been ordered since 1976. With over 90 plants cancelled since 1975, the US nuclear pipeline of new plants is expected to run dry soon. As Lester Brown, director of the Worldwatch Institute puts it, "present projections show US nuclear power production peaking in the nineties as the last plants under construction come onstream and as older plants built in the sixties and early seventies begin to close. The country that led the world into the age of nuclear power may well lead it out."

Does the fast breeder reactor represent an alternative to the light/heavy water thermal reactor? The fast breeder is basically a controlled bomb, or more accurately, several hundred "critical masses" or independent potential bombs put together in the core. The fast breeder reactor concentrates all the problems and hazards of the thermal nuclear reactor. The capital costs of the "experimental" fast reactors which follow few safety regulations, are at least twice as high as those of the thermal reactors. In India's case the fast breeder test reactor (FBTR) at Kalpakkam, magnifies all these problems.

The expense on atomic energy has not been without an enormous opportunity cost. Had the thousands of crores that have been spent on atomic energy been spent on other energy sources, they could have produced entirely different results: by conservative estimates, thousands of megawatts of coal-based power, tens of thousands of solar-driven pumps, lakhs of biogas plants, thousands of hectares of forests, incomparably more jobs and greater social and ecological benefits in a variety of fields.



The CIRUS reactor at Trombay is used for research purposes in India's atomic energy programme. (GOI)

# LIVING RESOURCES

*India's natural diversity, one of the richest in the world, is under attack, from disappearing varieties of wheat and rice to disappearing varieties of trees, cattle, buffaloes, goats, pigs, camels, ducks and fish.*

*At mid-century, Indian farmers cultivated 50,000 varieties of rice varieties. By 2,000, they will probably grow not more than 50.*

*Every single variety could be invaluable one day. A single sample of wild rice collected from eastern Uttar Pradesh in 1963 gave Asian farmers a gene that saved 30 million hectares of paddy from the dreaded grassy stunt virus.*

*Surveys in a small part of the Silent Valley in Kerala, saved from 'dammation' by a people's campaign, have revealed nine species and an entire* genus *of plants new to science.*

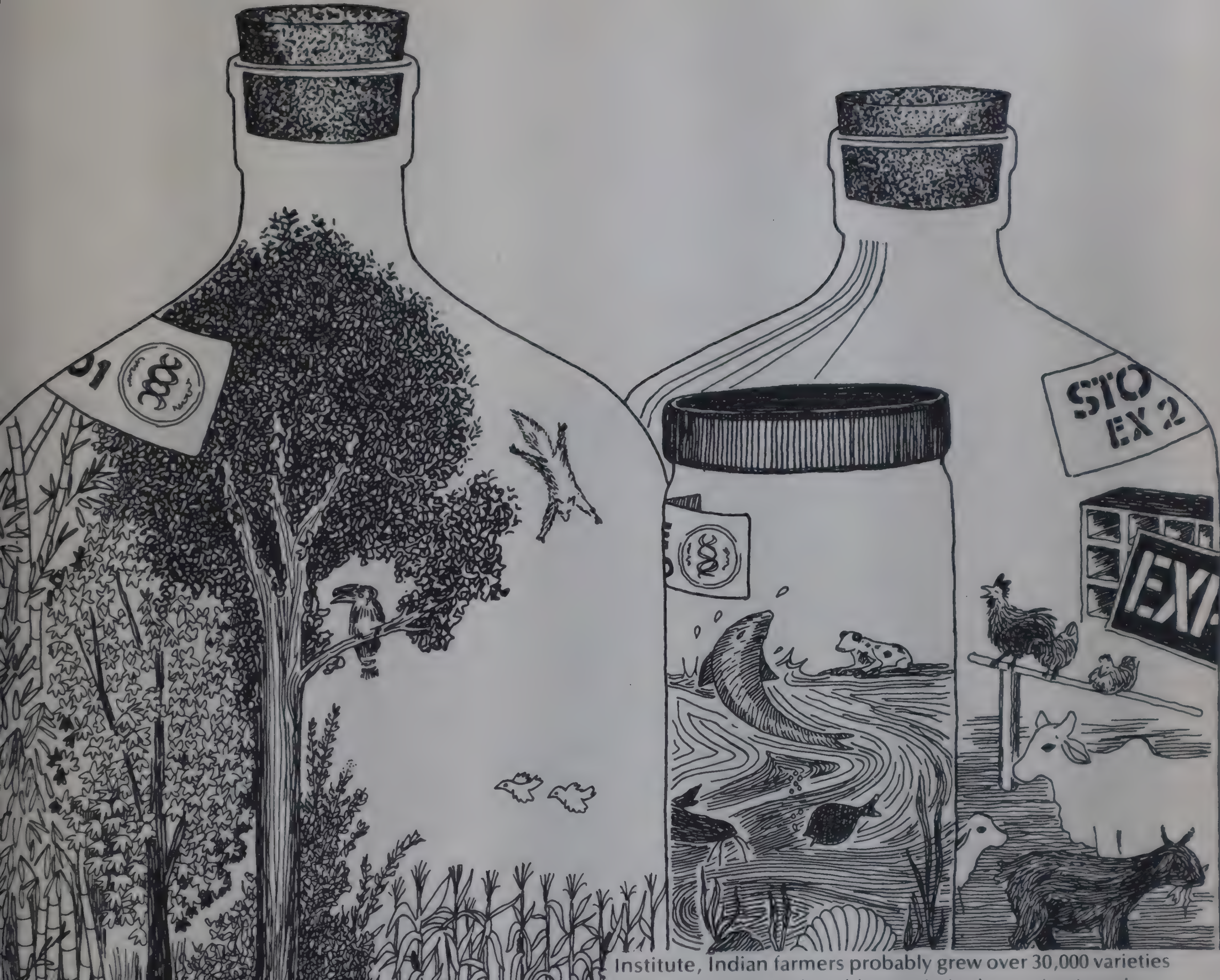
*Government efforts to preserve this precious natural heritage look better on paper. Although a national agency for plant genetic resources was set up eight years ago, no proper storage facility still exists.*

*High-yielding milk animals are being regularly brought to the cities from villages where they are slaughtered after lactation. High yielders are steadily disappearing and scientists estimate that buffaloes now yield about a tonne of milk less per every lactation period than their ancestors 60 years ago.*

*India killed 9,000 tonnes of frogs in 1981 to earn Rs 12 crore in foreign exchange. But 9,000 tonnes of mosquitoes and crop pests survive daily.*

*With nearly a quarter of India's forested lands now nature reserves, and with more than 3,000 tigers stalking them, people are turning against conservationists. Some 50 people are killed by tigers every year in the Sunderbans alone.*

*With the country's original forests and grasslands steadily destroyed, four weeds,—Lantana, Parthenium, Eupatorium and Water Hyacinth—are set to take over the land.*



India has a uniquely rich diversity of plant and animal life, which contributes in no small measure to the human economy. It is not just the wild living resources that are today threatened because of the destruction of their habitat, domestic species of plants and animals are also facing genetic attrition, partly because of those very activities that are undertaken by human beings in the name of economic development, such as the Green Revolution. According to Dr H.K. Jain, director of the Indian Agricultural Research Institute, Indian farmers probably grew over 30,000 varieties of rice. But with high yielding varieties becoming popular, these varieties are disappearing, and by the end of the century there will be no more than 50 varieties being used, with the top ten alone occupying over 75 per cent of the acreage. This genetic erosion, if carried too far, could threaten the very future of the human society. Protection and conservation of living species including domestic species, must, therefore, become an important issue for public policy and public pressure.

In recent years, the government has at least begun to take conservation of wildlife seriously. But the manner in which these conservation programmes are being conceived and implemented is creating more tension than peace and harmony. The following chapter shows that whereas conservation is an issue of crucial importance, it cannot be undertaken without the involvement of the people, especially those directly affected. Nature conservation programmes cannot be promoted in the same ham-handed way as those programmes which have destroyed nature. The result will inevitably be conflict and failure.

# GENETIC RESOURCES

Plant and animal life, as it has evolved on this earth, has produced a bewildering diversity. There are millions of species of plants and animals, but even within a species, there exists enormous diversity. For instance, there are an estimated 120,000 types of rice plants alone in the world, and this, too, is only a guess. There can actually be many more.

This massive diversity, or "gene pool", as scientists like to call it, is a common heritage of all human beings. It is also their insurance for future survival. Increasingly, as new varieties of plants and animals useful to human beings are bred, this massive gene bank provided by nature becomes important. Breeding is essentially an exercise in finding the desired gene from nature's vast genetic reservoir and introducing it into the genes normally used. The Green Revolution, for instance is essentially based on a strategy of genetic reconstruction aimed at producing new varieties of cereal plants which can produce high yields.

Scientists involved in this work, however, have also realised that the Green Revolution is something akin to riding a tiger; once you are on it, you have to stay on it to survive. To keep the Green Revolution going, breeders must produce new varieties every five to seven years as older high-yielding varieties succumb to pests and diseases, which themselves keep changing in intensity and character. If one variety covers too large an area for too long a time, it becomes an open invitation to disaster. A disease can sweep through a genetically uniform crop like wildfire leading to widespread crop failure and famine. The brown rust infection, for instance, affected large areas in north India planted under the wheat variety Kalyansona during 1973–74. Other than high yields, a high priority for both plant and animal breeders is the development of resistance to diseases, and screening available plant and animal varieties for these traits

**Stopping the Silent Valley dam saved not only the liontailed macaque from near extinction but also nine species of flora, a genus of plants and pest-resistant wild rice, all endemic to this area. (E. Hanumantha Rao)**

ccounts for a substantial amount of time and resources of reeders.

### hreat to genetic diversity

ronically using "superior" genes on a massive scale to ncrease production, as exemplified by the Green Revolution n food crops, blue revolution in fish production, white evolution in milk, and massive afforestation with high ielding monocultures, has posed one of the biggest threats o the world's genetic diversity in livestock, fish, crops and rees. In each of these areas, human beings are promoting a arrow genetic base—a few genes with highly desirable haracteristics—to increase production.

In this process, farmers can replace thousands of wild varieties and primitive cultivated varieties overnight with one high yielding variety. If the displaced varieties are not collected and properly stored, they could be lost forever. India has already lost thousands of traditional varieties of wheat since the beginning of the Green Revolution.

Simultaneously, environmental destruction caused by shifting cultivation, deforestation and dam building is destroying many wild varieties of even domesticated crop plants, trees and animals. Water pollution is affecting fish stocks and probably even genetic diversity. Overgrazing is affecting grass and tree populations.

However, no gene in this diverse nature can be considered useless and, thus, deserving to be driven to extinction. India possesses an extremely rich diversity of plant and animal life. The Indian region is considered one of the 12 centres of genetic diversity in the world. The total Indian flora consists of about 45,000 species, of which about 30,000 are non-flowering plants like algae and fungi which are usually inconspicuous and small. The flowering trees and plants of India consists of about 15,000 species but this number should not be taken as the final figure as several areas in the country remain unexplored and underexplored. From a very small area, Silent Valley in Kerala, covering less than 9000 hectares, the Botanical Survey of India recently discovered nine species new to science and a new genus of plants.

About 7000 endemic species are found in India, that is, they do not occur anywhere else in the world. Of these the Himalayas and the Khasi Hills in Meghalaya account for about 3000 endemic species, and the Deccan Peninsula for about 2000 species. The area of maximum diversity in India is northeastern India which is also the most threatened. The second major area of genetic diversity is the lower region of the Western Ghats around the Nilgiris. Over 1500 of the rare flowering plants are subjected to a lesser or greater degree of threatened extinction.

### Valuable Indian genes

Just as India has benefitted from plant and animal genes from all over the world, India, too, has given to the rest of the world many valuable genes. Probably the most dramatic case is that of a single sample of wild rice, *Oryza nivara* collected by botanist S.D. Sharma from eastern U P in 1963. Grassy stunt virus is one of the four major diseases of rice plants. During the early 1970s, grassy stunt epidemics destroyed more than 116,000 hectares of rice in Indonesia, India, Sri Lanka, Vietnam and the Philippines. At the International Rice Research Institute in Los Banos (Philippines), Gurdev Khush and K.C. Ling searched 6723 samples of cultivated and wild rice varieties looking for resistance to grassy stunt virus. Only one sample, that of Sharma's, displayed the resistance they were looking for. Today, the genes from this sample are used in resistant varieties grown on 30 million hectares in India, Nepal, Bangladesh, China and Southeast Asia. The disease has almost ceased to exist. In Indonesia these genes have helped push average production per hectare to six tonnes and in some cases to 10 tonnes. Two or three crops have become common and rice production overall has doubled.

**The green revolution heralds doom for thousands of rice species like this Oryza plant — (H.K. Jain)**

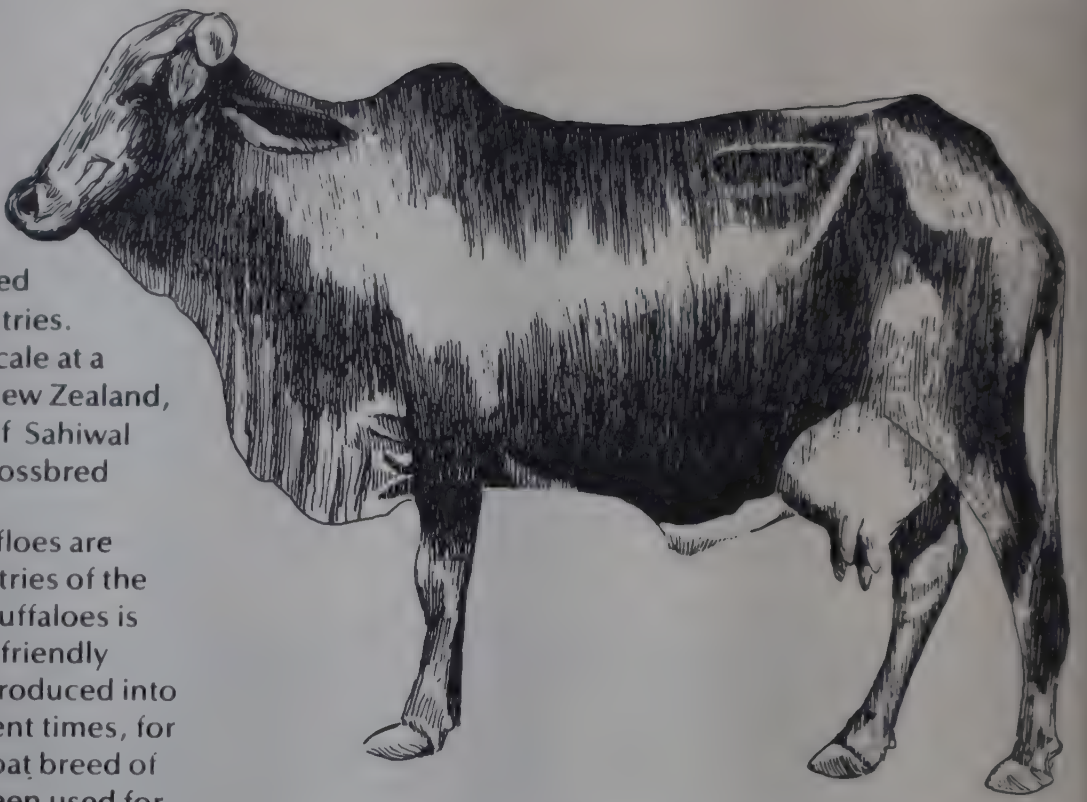
In an interconnected world, Sharma's rice sample has helped India to repay a debt. Indonesian wild genes have helped India to set up a sugarcane industry. The limiting factor to commercial sugarcane production in India used to be the red rot disease. Then resistance was acquired from the wild Indonesian cane *Saccharum spontaneum*. Indonesian *S. spontaneum* genes are now present in important commercial varieties of sugarcane used in such top sugar-producing countries as Cuba, Mexico, USA, Argentina, Brazil, Columbia, China, India, Indonesia, Pakistan, Philippines, Thailand and Australia. Today equally widespread are *S. spontaneum* clones from India, which are sources of resistance to gummosis and root rot.

The list of valuable genes discovered in India is long. Large areas of the world, for instance, are covered by unproductive saline soils. Tolerance to salinity in rice has been found in several traditional varieties from southern India and Sri Lanka. A wild melon from India has provided resistance to a form of mildew and has saved the melon crop in California, USA.

### Indian animal breeds

Among animals, too, many Indian breeds are known all over the world. The home tract of the famous Sahiwal cattle is in the Sahiwal district of Pakistan. At the time of partition, only a few Sahiwal herds existed in India. A few more animals were brought by migrating Sikh and Hindu families. Today, the Sahiwal population in India consists of about to 1000-1100 breeding females. The breed is being used for crossbreeding in many countries. Sahiwal semen is being produced on a large scale at a farm in Queensland (Australia) for export to New Zealand, which, in turn, after contract matings by use of Sahiwal semen on Jersey and Friesian cows, exports crossbred heifers to Southeast Asian countries.

The famous Murrah, Nili-Ravi and Surti buffloes are being used to upgrade buffaloes in many countries of the world. In Vietnam, a consignment of Murrah buffaloes is widely regarded as the most valuable gift from friendly India. The Jagarabadi has been successfully introduced into lands in which buffaloes did not exist until recent times, for example, Brazil and Trinidad. The Jamnapari goat breed of the Chambal ravines in Etah district (UP) has been used for improvement of native breeds in several countries. The famous English Anglo-Nubian breed, which has been extensively used for crossbreeding, is itself based on a cross of the Jamnapari.



**Sahiwal cow**

### Insect germplasm

Even germplasm of economically important insects needs to be preserved. The two insect livestock groups of major world importance are honey bees and silkworms. There are many strains of honey bee, and there is great variation within the strains for characteristics such as honey production and disease resistance. Though efforts to collect wild bee germplasm seem to be a long way off because of various technical reasons, the need is being increasingly felt.

Work on breeding has already been done with the mulberry silkworm. In India, wild forms of the tasar silkworms (*Antheraea* species) are being used for improvement. *Antheraea roylei* from India and *A. pernyi* from China have been crossed to produce the hybrid *A. proylei.* Silk from the hybrid is claimed to be the finest ever produced in India and the new species also outyields its parents by almost 170 per cent in weight of silk and 94 per cent in filament length. The hybrid is expected to play a major part in efforts to expand the tasar silk industry and provide rural employment.

### Conserving micro-organisms

In a recent lecture on genetic conservation, Dr M.S. Swaminathan, one of India's leading agricultural scientists and director-general of the International Rice Research Institute,drew attention to the need to conserve even micro-organisms. There has been an enormous growth of interest in biological nitrogen fixing organisms because of the ill effects of chemical fertilisers on the environment. Among the major sources of biofertilisation are blue green algae and azolla. Azolla germplasm from all over the world is already being collected at the International Rice Research Institute. Azolla is an aquatic fern capable of fixing atmospheric nitrogen through a symbiotic blue green algae living in the cavities of its leaves. It has long been used in China and Vietnam as green manure in rice fields and its use is growing in other Southeast Asian countries now.

Blue green algae (BGA) is being extensively promoted in India as a cheap source for fixing nitrogen in paddy fields. Unfortunately, there is no organised effort to collect BGA for genetic conservation purpose. Strains recorded during ecological studies are not kept by the scientists because maintenance of a culture collection is time consuming and expensive. Scientists have achieved considerable success in selecting strains of Rhizobia nitrogen fixing bacteria which live in the roots of leguminous plants, and give them their nitrogen fixing abilities. This success indicates the possibility that superior strains may exist in other nitrogen fixing organisms, too.

Today, the world's main food supply is determined by only 20 crop species, and only eight forest species provide most of the world's wood and timber. Similarly, about 20 animal species provide most of the world's milk, wool, hide and draught power. A much larger number of plants do provide food, such as oil, vegetables, fruits and fodder, and meet other needs, such as spices, beverages, medicines, ornamentals and industrial raw materials. However, all these plants and animals constitute only a fraction of all the plant and animal species in the world.

It is impossible to guess what this natural wealth will yield in the future. But the potential can be seen from the vast variety of medicines alone that plants have given to humankind. The Ayurvedic system of India gave to the world reserpine, a tranquiliser and a treatment for hypertension, anxiety and schizophrenia. Reserpine is a therapeutic agent extracted from a herb, *Rauwolfia serpentina*, which is now almost impossible to find in forests.

### edicinal herbs

n India, at least 2500 plants are used for medicinal urposes. The roots of the berberry shrub found in the Himalayan foothills are an important source of berberin, a ompound used widely in tropical Asia and Japan against iarrhoea. A single species, *Strychnos nuxvomica*, indicates he commercial value of drug producing plants. A source of he compounds strychnine and brucine, this species earns ndia over Rs 50 lakh yearly in exports. India's total exports of plant-based chemical products, mainly medicines and pharmaceuticals, are worth over Rs 55 crore yearly, a trade which increased five-fold during the 1970s. It is distressing that overexploited medicinal plants face probably the greatest threat of extinction in India today.

From an ethical point of view, too, there are strong arguments against human beings driving any life form into extinction. But protecting the wonderful gene bank provided by nature is an issue on which both utilitarian and ethical perspectives coincide.

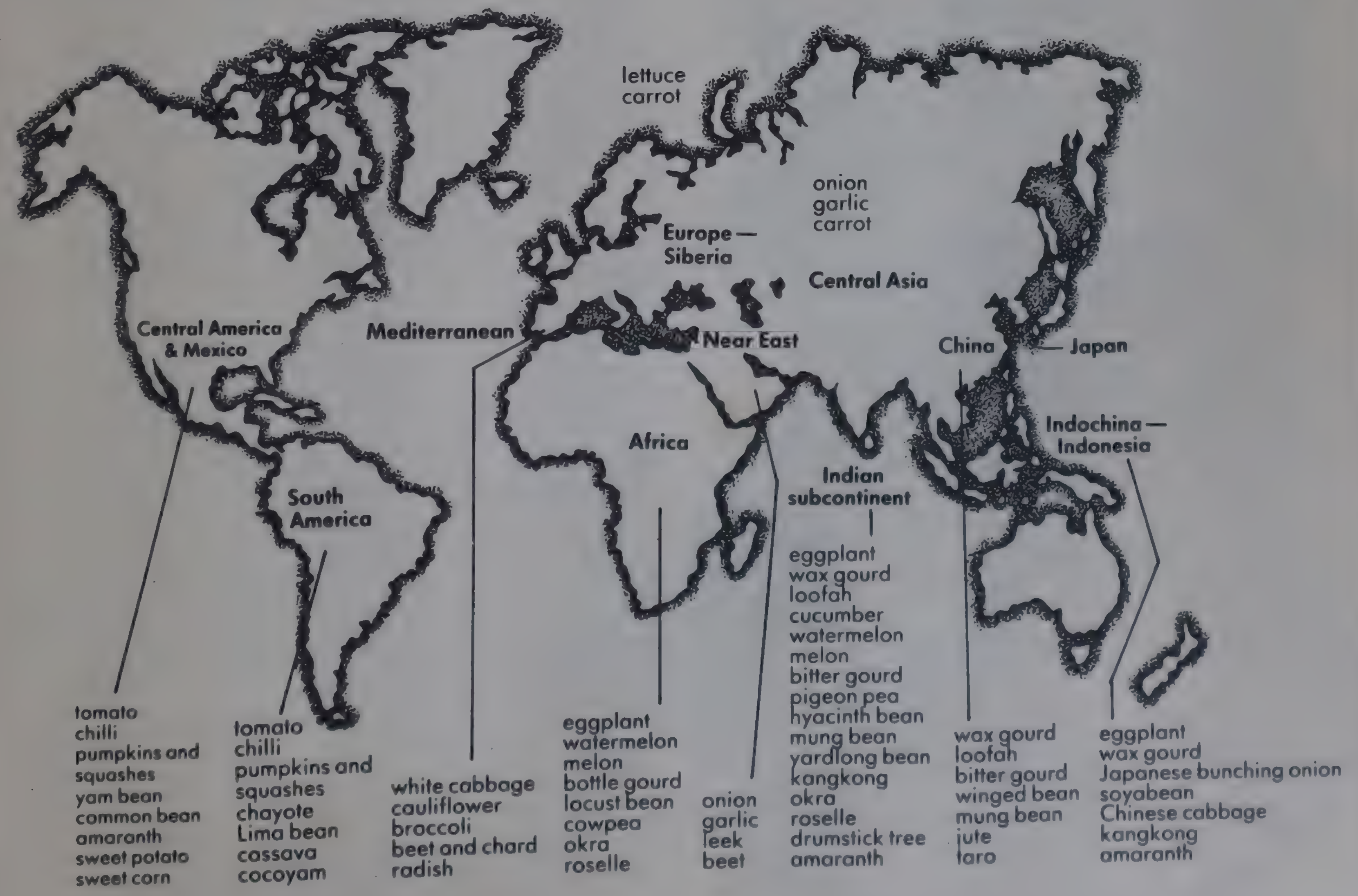
## Crop genetic resources

India is known especially for its rich genetic wealth of bamboo, fruit trees (mango, banana and citrus), vegetables like eggplant, okra and cucurbits (melons and gourds), grain legumes (mung beans, urad or black gram and cowpeas), rice, pepper, cardamom, ginger, turmeric, sugarcane, jute, and various medicinal and aromatic plants. There is also a rich diversity in wheat, maize, millets, oilseeds and various other fruits, spices, vegetables, fodder and plantation crops.

Plant species from India have not only influenced agricultural development in the region but also in many other parts of the world. Plants were taken from India to the ancient civilisations of the Tigris, Euphrates and Nile river basins. Many Arab traders took plant materials to Mediterranean countries in the 8th-10th centuries AD Buddhists took several Indian cultivated plants to Southeast Asian Countries.

Centres of diversity of important vegetables

Source: International Bureau of Plant Genetic Resources, Rome


lettuce
carrot
onion
garlic
carrot
Europe — Siberia
Central Asia
Central America & Mexico
Mediterranean
Near East
China
Japan
Africa
Indochina — Indonesia
South America
Indian subcontinent
eggplant
wax gourd
loofah
cucumber
watermelon
melon
bitter gourd
pigeon pea
hyacinth bean
mung bean
yardlong bean
kangkong
okra
roselle
drumstick tree
amaranth
tomato
chilli
pumpkins and squashes
yam bean
common bean
amaranth
sweet potato
sweet corn
tomato
chilli
pumpkins and squashes
chayote
Lima bean
cassava
cocoyam
white cabbage
cauliflower
broccoli
beet and chard
radish
eggplant
watermelon
melon
bottle gourd
locust bean
cowpea
okra
roselle
onion
garlic
leek
beet
wax gourd
loofah
bitter gourd
winged bean
mung bean
jute
taro
eggplant
wax gourd
Japanese bunching onion
soyabean
Chinese cabbage
kangkong
amaranth

## Seeds of discontent

Are plants and seeds the common heritage of humankind or should governments allow private companies and individuals to patent seeds and build up private gene banks? The question has sparked off an international controversy, especially as many western breeders are setting up patenting arrangements to promote private plant breeding programmes.

Seven European governments have set up the International Union for the Protection of New Varieties of Plants (UPOV): Participants have agreed to a system of reciprocal royalties and patent protection. The European Economic Community (EEC) has established a system of 'legal' and 'illegal' varieties with only the legal varieties eligible for sale and has produced a common catalogue of vegetable varieties.

Voluntary organisations in the West are afraid that these patenting arrangements will provide an excellent opportunity for multinational agribusiness to enter the seeds business in a big way. Indeed, major chemical companies like Shell, Ciba Geigy and Sandoz have recently bought many seed companies and are today the world's leading seed companies. Campaign groups allege that these multinationals are out to control all major agricultural inputs from pesticides to seeds.

Seed patents have recently become the focus of attention in many international forums. The main issue is that while plant breeders are keen to possess patent rights to their improved seeds, they do not recognise the rights of the countries from which the original seeds were obtained. Most seeds used for crossing and producing new and improved varieties of plants come from the developing world which is rich in genetic diversity whereas plant breeding activities are concentrated in the developed countries.

The South is gene rich, the North is crop-rich. For instance every Canadian wheat variety contains genes introduced from up to 14 different Third World countries. In several cases, countries which exported the original germplasm have been forced to purchase the improved varieties.

Seed patents will greatly affect those Third World countries with little agricultural research activity. India produces its own seeds, mainly through public sector companies, and will not be affected to the same extent.

The Brussels-based International Coalition on Development Action (ICDA) feels that if Western breeders ask for protection for their innovative work in improving nature, Third World countries could ask for royalties for parting with their natural resources. After all it is this germplasm that has created agricultural abundance in industrialised nations and has protected crops against pests.

Of equal concern is the fact that plant breeding institutions in the West are collecting germplasm from all over the world and

### The control of major crop germplasm

| Crop | Percentage North | Percentage South | Percentage IARCs |
|---|---|---|---|
| **Cereals** | | | |
| Wheat | 75 | 21 | 4 |
| Rice | 22 | 44 | 34 |
| Maize | 56 | 29 | 15 |
| Barley | 80 | 12 | 8 |
| Sorghum | 52 | 27 | 21 |
| Millets | 36 | 35 | 29 |
| **Food legumes** | | | |
| Root crops | 47 | 23 | 30 |
| Potato | 43 | 21 | 36 |
| Cassava (Manioc) | — | 68 | 32 |
| Sweet Potato | 53 | 42 | 5 |
| Aroids | 29 | 69 | 2 |
| Yam | — | 92 | 8 |
| **Vegetables** | | | |
| Okra | 23 | 77 | — |
| Allium | 77 | 23 | — |
| Amaranthus | 16 | 84 | — |
| Capsicum | 76 | 24 | — |
| Crucifers | 74 | 26 | — |
| Cucurbita | 95 | 5 | — |
| Tomato | 72 | 28 | — |
| Eggplant | 72 | 28 | — |
| Other vegetables | 89 | 11 | — |
| **Fruits** | | | |
| Avocado | 84 | 16 | — |
| Banana | — | 96 | — |
| Citrus | 75 | 25 | — |
| Mango | 5 | 95 | — |
| Pineapple | 1 | 99 | — |
| **Industrial** | | | |
| Cacao | 4 | 96 | — |
| Coconut | 1 | 99 | — |
| Pepper | — | 100 | — |
| Rubber | 3 | 97 | — |
| Sugarcane | 33 | 67 | — |
| Tea | 9 | 91 | — |

IARCs: International Agricultural Research Centres

Source: Hammarskjold Foundation, Sweden.

**The control of plant genetic resources between Developed Countries, Developing countries and International Agricultural Research Centres**

| Grouping of states | Percentage |
|---|---|
| Developed countries | 55 |
| Western developed countries (US 22%, UK 4%) | 41 |
| Western communist states (USSR 7%) | 14 |
| Developing countries (India 6%, Malaysia 6%, China 3%) | 31 |
| International Agricultural Research Centres | 14 |

Source: Dag Hammarksjold Foundation, Sweden

storing them in their own countries. The Western countries may one day refuse even the country of origin access to those seeds.

At the 22nd Conference of the UN Food and Agriculture Organisation held in 1983, a resolution was adopted launching an International Undertaking on Plant Genetic Resources. The undertaking did not have a legally binding character but asked for various commitments by governments in order to safeguard plant genetic resources and to ensure their unrestricted availability for the purposes of plant breeding and agricultural development of all countries.

The International Organisation of Consumers Unions had pleaded for a legally binding document. It fears that a voluntary undertaking might ultimately help only the developed nations. Such an undertaking might only legitimise the rights of the industrialised countries to access to the germplasm of Third World countries without guaranteeing developing nations access to the genetic material obtained on the basis of that germplasm. For instance, the so called advanced breeder lines could be excluded from the undertaking. Several "new" varieties of the 20th century are no more than accidental discoveries or relatively simple crossings with accessions in gene banks.

For instance, the zera-zera sorghum cultivated for centuries by African peasants and donated by Sudan is now the basis for hybrid sorghums used widely today. While zera-zera sorghum is vanishing, international chemical companies have become dominant in sorghum breeding and, in fact, one company attempted to market a hybrid grain sorghum based upon zera-zera sorghum back to the Sudan, endangering the remaining genetic diversity in that country.

An international gene collection and storage system is obviously needed urgently. With deforestation and environmental destruction, developing countries may soon find that they have lost their genetic richness and what remains is inaccessible in Western treasure houses. In such a situation the world's plant genetic resources, the key to human survival will be worth a million times their weight in gold. Former US secretary of state, Edmund Muskie has, not surprisingly, described genetic resources as "a new dimension of national security" and leading British environmentalist, Norman Myers reports that the CIA, partially responsible for supplies of raw materials critical to the US economy, has been taking an interest in gene reservoirs overseas that could become increasingly important to US agriculture. Myers recently wrote in the Guardian, London that the agency is assessing political proclivities of the countries to determine whether they will remain suitably disposed to the US.

But will the US ensure access to those countries from which it has taken seeds in the first place?

It is estimated that about 250 Indian species have wild plants of agricultural and horticultural importance and of these about 60 are rare or endemic. Though many wild varieties have been collected and used in breeding programmes, only a fraction of the job has been done. India is also very rich in its natural wealth of forage legumes and grasses. About 2000 such species occur, of which two-thirds are grasses.

The northeastern Himalayas are a veritable mine of valuable genes in many crops and fruit trees. Unfortunately because of shifting cultivation and widespread habitat destruction, this genetic wealth faces the threat of extinction. Dr Bhag Singh of the National Bureau of Plant Genetic Resources (NBPGR), for instance, discovered *Citrus indica*, an endangered species of citrus, in the Tura range of the Garo Hills, Meghalaya. This species is the most primitive of citrus species and perhaps the progenitor of cultivated materials. Citrus fruits are native to South Asia and the northeastern Himalayas hold a notably important position in the world with regard to citrus wealth. The Khasi and Garo tribes grow citrus trees in and around the vicinity of their houses.

### Varieties of rice

A major crop in India and Asia, rice has attracted the maximum interest amongst Indian scientists interested in plant genetic resources. The areas with maximum diversity in India are the northeastern tracts and the hilly regions of Orissa, Bihar, Madhya Pradesh and Andhra Pradesh, which are mostly inhabited by tribal populations. Various local rice varieties have also been found in the Malabar region and in the cold Himalayan tracts.

A national survey estimated that although about 50,000 local rice varieties are still in cultivation, they are being rapidly lost, particularly in the irrigated tracts, where new high yielding varieties have been adopted. Growing deforestation poses a serious threat to many wild varieties of rice. Tropical rain forest habitats have been important sources of disease and pest resistant varieties of rice. The Silent Valley forest reserve area in Kerala, which was to have been inundated with the construction of a hydroelectric project, has been an important source of resistant genes now incorporated into many Pattambi rice lines. The Assam hills in the Northeast are another invaluable source of rice germplasm in the form of the well-known Assam Rice Collection (ARC). Together with the threatened cultivated varieties, these endangered natural habitats should be a priority area for immediate collection of wild varieties. In a germplasm conservation programme, the wild species are as important as, or more important than local cultivated varieties.

A total of nearly 15,200 local rice varieties are being maintained at the national rice gene bank at the Central Rice Research Institute (CRRI) at Cuttack, and an estimated 35,000 local varieties are held as working collections at 40 rice research stations. Thus there is a total collection of 50,000 cultivars (cultivated varieties). Assuming 50 per cent of the collection to be duplicates, the national collection is now estimated at 25,000 with scope for further collection of another 25,000 varieties.

The genus *Oryza* (rice) consist of about 24 species, out of which only two are cultivated: *O.sativa* (Asian rice) and *O.glaberrima* (African rice ). Collection of wild varieties has

**Endangered plants of actual or potential use in traditional medicine**

| Species | Common name | Use |
|---|---|---|
| *Aconitum deinorrhizum* | Atis | Medicine |
| *Acorus calamus* | Vacha | Sedative |
| *Alpinia galanga* | Khulanjan | Drug |
| *Atropa awminata* | Angurshaga | Medicine |
| *Commiphora wightii* | Guggal | Drug |
| *Coptis teeta* | Mishmee teeta | Medicine |
| *Dendrobium nobile* | — | Dendrobine |
| *Dendrobium pauciflorum* | Picotee dendrobium | Alkaloids |
| *Dioscorea deltoidea* | Kins | Cortisone |
| *Diplomeris hirsuta* | Snow orchid | Alkaloids |
| *Gentiana kurroo* | Kadu | Drug |
| *Nelumbo nucifera* | Lotus | Drug |
| *Paphiopedilum druryi* | — | Alkaloids |
| *Podophyllum hexandrum* | Indian podophyllum | Drug |
| *Rauvolfia serpentina* | Sarpagandha | Drug |
| *Santalum album* | Sukhad | Drug |
| *Saussurea lappa* | Kuth roots | Various uses |
| *Saussurea obovallata* | Brahm Kamal | Medicine |

Source: World Health Organization

lagged behind those of cultivated varieties. The group *O.rufipogon*, *O.nivara* and *O.meridonalis*, is the most closely related to the widely cultivated *O sativa* rices and represents the progenitors of the cultivated rices. Although as genetic resources, their importance is paramount, unfortunately, they are fast disappearing.

This group occurs in one of the densely populated areas of the world, where the habitat is being reclaimed for cultivation of crops, construction of roads and buildings. The cultivation of *O.sativa* rices is coming closer to the population of these wild species which are thereby losing their genetic identity by being "swamped" by the genes of *O.sativa*. A time bound collection programme for the wild rices in this group is thus urgently needed.

The group *O.collina*, *O.officinalis*, *O.minuta* and *O.malampuzhaensis* are Asian rice species which occur in forests in partial shade, by the side of running streams or swamps. With deforestation, this group is also endangered. The present collection of *O.officinalis* from South Asia is not representative of their natural distribution. It is important to collect these species before they disappear.

In India, the CRRI is aided by 10 base centres at Simla, Almora, Jodhpur, Ranchi, Shillong, Cuttack, Hyderabad, Akola, Trichur and New Delhi. These centres collect not just germplasm for rice but also for a wide range of other crops. Each centre has been allocated a state or region in which it actively collects. In future collections of wild rices, cultivated varieties, upland rainfed rices, flood-tolerant lowland rices, and varieties displaying saline-alkaline tolerance, cold tolerance, pest and disease resistance, and aromatic and quality characters will be emphasised. Collecting these wild species and peripheral populations under severe pressure may require specialised collectors and the creation of "gene sanctuaries" to protect threatened habitats.

According to Dr M.S.Swaminathan, the collection of germplasm should not only involve professional scientists with expert knowledge of rice but also farmers, the general public and the defence services. In China, for example, each provincial academy mobilises farmers to send in seeds of traditional varieties. Although some samples will be duplicated, this system lessens the work of the scientists and lets them concentrate on classifying the material and identifying duplicates and distinct types. As some of the high priority germplasm collection areas and endangered habitats are in either sensitive border zones or inaccessible regions, defence personnel could also play an important role in collecting germplasm.

**Vulnerable plant species**

Amongst the most vulnerable plant species in India are overexploited medicinal plants, ornamental plants like orchids and botanical curiosities like pitcher plants. Some 1250 species of orchids occur in India, of which 300 are found in Meghalaya alone. About 20 species of orchids are becoming scarce in Meghalaya. Scientists from the Botanical Survey of India (BSI) recently made intensive studies on a group of beautiful orchids called *Coelogyne*, but failed to see even one plant of three species, namely, *C.albolutea*, *C.assamica* and *C.treutleri* in living condition. They have probably become extinct. Even their preserved specimens are not available in any herbarium. The Government of Meghalaya has recently established a "pitcher plant sanctuary" in the Khasi Hills. The Indian National Orchidarium at Shillong has brought approximately 350 indigenous orchid species into cultivation for conservation purposes. But much more needs to be done in this connection. For example, a rhododendron sanctuary is urgently needed in Sikkim.

The loss of valuable medicinal plants is definitely a matter of great concern, though few attempts have been made as yet to collect their germplasm, Amongst the

*Paphipedilum villosum*, **an endangered variety of orchids found in the Northeast (H.K. Jain)**

## Indian national priorities for collection of plant germplasm

| | Priority 1 | Priority 2 | Priority 3 |
|---|---|---|---|
| CEREALS | Rice<br>Wheat | Maize<br>Barley | Buckwheat/<br>Amaranth |
| MILLETS | Sorghum<br>Pearl millet<br>Finger millet | Lesser millets | |
| GRAIN LEGUMES | Pigeon pea<br>Green gram<br>Black gram<br>Cowpea<br>Chickpea | Lentil | Winged bean<br>Rice bean<br>Soybean<br>Moth bean |
| OILSEEDS | Coconut<br>Brassica species<br>Sesame<br>Groundnut | Safflower | |
| FIBRE CROPS | Cotton | Jute | Kenaf, Mesta |
| VEGETABLES | | Okra<br>Egg Plant<br>Beans<br>Cucurbits<br>Non-tuberiferous Solanums | |
| TUBER CROPS | | | Yams and aroids<br>*Pachyrrhizus*<br>Sweet potato |
| FRUIT CROPS | Banana<br>Citrus | Mango<br>Jackfruit | Papaya<br>Guava<br>Litchi<br>*Syzygium* (Jamun)<br>*Phyllanthus*<br>*Morus*<br>*Zizyphus* (ber) |
| SUGAR-YIELDING PLANTS | Sugarcane | | |
| BEVERAGES | Coffee | Tea | |
| SPICES | Pepper | Turmeric<br>Arecanut | Ginger |
| MEDICINAL AROMATIC PLANTS | | Dioscorea<br>Rauvolfia<br>Cymbopogon species (Lemon grass, Citronella grass, Palmarosa oil grass)<br>Opium poppy<br>Senna<br>Vinca | |

**Nepenthes, a disappearing variety of pitcher plants (H.K. Jain)**

endangered medicinal plants are three orchids: *Paphiopedilum druryi* a native to Kerala, which is endangered or extinct in the wild due to forest fires and excessive collecting; *Dendrobium pauciflorum*, found in West Bengal and Sikkim in areas open to tree felling, which is also endangered, possibly extinct; and, *Diplomeris birsuta*, restricted to a tiny population in West Bengal and is vulnerable to landslides. A decrease in its number has been noted by botanists. The numbers of another orchid, *Dendrobium nobile* are seriously declining. This orchid occurs in the Himalayan regions of India and China and is the source of dendrobine which is still exported from China by the ton in a dehydrated form.

Several other medicinal plants are being seriously threatened because of overexploitation. *Acorus calamus*, known as vacha in India, is used in 51 different drug preparatios. It used to be common in Manipur and the Naga Hills, but today it is so scarce that it has to be imported from overseas. *Rauwolfia serpentina*, the source of reserpine, known to Ayurveda for centuries, was once common and abundant in forest areas all over peninsular India. But after scientists isolated the alkaloid reserpine in 1952, a ruthless search was started all over the country, which came to a halt only when the plant almost disappeared from forest areas. Today it is extremely rare in nature and is mainly found in cultivated stands. Variations within the species may have been lost already.

Two other species that are extensively used in Ayurveda and are today endangered are *Saussurea lappa*, the source of kuth roots, and *Dioscorea deltoidea*, the source of steroidal hormone. Today these plants are listed in the Convention on International Trade in Endangered Species and cannot be exported without an export permit. *Dioscorea deltoidea*, much sought after by private agencies and pharmaceutical firms, has been continuously collected in India except perhaps in the inaccessible areas of the Himalayas. The roots yield cortisone, a steroidal hormone used in treating rheumatic diseases and ophthalmic disorders.

The need to preserve the medicinal plants of India is clearly vital and urgent. Maintenance of botanical/herbal gardens will not be a solution. Efforts will have to be made to conserve the germplasm of each important species of medicinal plants. The National Bureau of Plant Genetic Resources (NBPGR) has only made a beginning by collecting Opium Poppy, Syllium, Senna and *Rauwolfia Serpentina*. The NBPGR has a major role to play in the protection of the country's vital genetic treasure. But the Indian Council of Agricultural Research (ICAR), which supervises NBPGR, will have to be more effective in energising this organisation than it has been so far. Germplasm conservation is a complex task. Clear priorities have to be set in collecting germplasm. There should be an understanding of how extensive the existing collections are and duplicates should be weeded out. Collected seeds should be stored carefully. They must be properly characterised for their attributes and then made available to breeders for use. Finally, there should be adequate facilites for multiplication of seeds while duplicate samples should be kept as an insurance.

Although the NBPGR was set up in 1976, it has still not built a proper storage facility for collected germplasm. Funds were allocated for the construction of a storage facility in 1978 but it took three years just to choose the site. It has taken a further three years to finalise architectural details, with Central Public Works Department officials anxious to

**Major gene banks in India**

| Name of Plant | Accessions | Term of storage | Institution | Location |
|---|---|---|---|---|
| Rice (*Oryza sativa*) | 30,000 | Medium | IARI | New Delhi |
| | 15,249 | Medium | CRRI | Cuttack |
| Sorghum (*Sorghum bicolor*) | 24,000 | Medium* | ICRISAT | Hyderabad |
| Pearl Millet (*Pennisetum typhoides*) | 14,340 | Medium* | ICRISAT | Hyderabad |
| | 2,247 | Short | AICMIP | Poona |
| Foxtail Millet (*Setaria italica*) | 5,017 | Short | AICMIP | India |
| | 1,160 | Medium | ICRISAT | Hyderabad |
| Finger Millet (*Eleusine coracana*) | 5,904 | Short | AICMIP | India |
| | 1,241 | Medium* | ICRISAT | Hyderabad |
| Kodo Millet (*Paspalum scrobiculatum*) | 1,405 | Short | AICMIP | Poona |
| Cassava (*Manihot*) | 1,800 | Short | CTCRI | Kerala |
| Mungbean (*Phaseolus aureus*) | 3,000 | Short | PAU | Ludhiana |
| | 1,000 | Short | IARI | Delhi |
| Chickpea (*Cicer arietinum*) | 13,000 | Medium* | ICRISAT | Hyderabad |
| Pigeonpea (*Cajanus cajan*) | 8,850 | Medium | ICRISAT | Hyderabad |
| Groundnut (*Arachis hypogaea*) | 8,800 | Medium | ICRISAT | Hyderabad |
| Winged Bean (*Psophocarpus tetragonolobus*) | 1,000 | Short | NBPGR | Delhi |

* Long-term facility under development

| | | |
|---|---|---|
| IARI | : | Indian Agricultural Research Institute |
| CRRI | : | Central Rice Research Institute |
| ICRISAT | : | International Crops Research Institute for Semi-Arid Tropics |
| AICMIP | : | All India Coordinated Millet Improvement programme |
| CTCRI | : | Central Tuber Crops Research Institute |
| PAU | : | Punjab Agricultural University |
| NBPGR | : | National Bureau of Plant Genetic Resources. |

sit Europe to look at existing storage systems. There is still o firm date by which the storage facility will be built.

In such circumstances seeds have to be sown every year nd recollected. One can only guess how well the pecimens have been kept. It is quite possible that many amples have been lost or are mixed up. The state of the rice ollection at the Central Rice Research Institute should also e a matter of public concern. CRRI too does not have a ong-term storage facility. In the humid climate of Orissa, he viability of rice seeds is generally not more than six nonths. Consequently, many scientists lack confidence in NBPGR and prefer to keep their collections with themselves.

The most extensive collection of rice from the Chattisgarh region was made by Dr R.H. Richharia. Beginning in 1971 while working as the agricultural adviser o the government of MP, Richharia collected, with single minded devotion, some 18,000 samples of rice. Though many of these may be duplicates, Richharia's vast collection became the nucleus for the breeding activities of the MP Rice Research Institute (MPRRI), which began in 1976 and was later merged with J.N. Agricultural University. Richharia, in fact, argued that it is the higher-yielding among these indigenous varieties which need few inputs, that should be propagated in India's poorer areas. Tribal farmers, for instance, cannot afford expensive inputs that are needed to make exotic rice varieties produce high yields. With low inputs, many indigenous varieties will outyield the so-called high-yielding imported varieties. The work of collecting rice varieties in Chattisgarh has almost come to a halt since MPRRI was closed down in 1978 allegedly under World Bank pressure. Doubts have been expressed about the care with which Richharia's collection has been kept.

## Animal genetic resources

India has a rich diversity of animal life which is threatened by a number of factors. Even as scientists discover new breeds like the Siri cattle in Sikkim, and although many species are nowhere near extinction, they are undergoing a process of genetic erosion. Urban centres attract cows and buffaloes with the highest milk yield from the rural areas. But from they there go to the slaughterhouses, after completion of lactation. Thus, high producing animals (genotypes) are being regularly removed from the breeding tracts, leaving inferior genotypes for breeding.

P.N.Bhat, one of India's leading animal geneticists, believes that the genetic quality of the famous Murrah breed has deteriorated. The maximum recorded milk yield in a lactation for a Murrah buffalo was obtained in 1932 with one female yielding about 4000 kg in a lactation of 310 days. It is difficult now to find buffaloes recording better than 2500 kg per lactation. It has been estimated that between 1921 and 1979 the loss in average lactational yield of good producers due to the genetic erosion caused by slaughterhouses and other factors has been of the order of 1000 kg.

### Cattle and buffaloes

India has 26 breeds of cattle and seven of buffaloes, together with a number of nondescripts, which account for about 75 per cent of the total cattle population. The improved and specialised breeds are generally found in the northwestern and western dry areas.

**India has the world's largest cattle population. But superior breeds are a diminishing herd. (FAO)**

Indiscriminate crossbreeding with exotic breeds poses a serious threat to indigenous breeds. Already crossbreeding with temperate breeds has made inroads into good draught breeds. Bhat argues that the need for crossbreeding in their breeding tracts needs to be evaluated and stopped if erosion is large, so that the local breed may not be lost.

Some of the finest milk breeds are facing constant erosion, says Bhat, both because of indiscriminate crossbreeding and neglect. There have been no practical breeding programmes for genetic improvement of the indigenous breeds. These breeds are not in as good a genetic condition as they were a few centuries ago. Mass artificial insemination and import of exotic stock for cross breeding has now made it impossible even to locate genetically superior animals of Sahiwal, Red Sindhi and Tharparker breeds in India. "Pure specimens of Rathi breed are fast becoming difficult to find; similarly high producing Kankrej and Gir animals are becoming rarer and rarer," laments Bhat. Among cattle, the good milk breeds like Sahiwal and Red Sindhi and dual-purpose breeds like Tharparker and Rathi are in acute danger of being lost in

their pure form from India.

Bhat himself believes that livestock breeds which can sustain and produce on low agricultural inputs should be identified and selected in animal research programmes in tropical countries. There is little point in introducing animals which need high inputs to produce efficiently in conditions of poverty.

Apart from the humped cattle, there are in the north-eastern Himalayas a number of wild, semi-wild and domesticated humpless cattle. Economically the most important is the mithun (*Bos frontalis*), raised primarily for meat, sacrifice and bride price. The mithun is believed to have arisen from the cross of Gaur, the wild cattle of the Indo-Malaysian region, with domestic cows, The 1972 census revealed 121,000 mithuns in Arunachal Pradesh, Nagaland, Tripura and Manipur. The mithun lives mainly in semi-wild conditions at an altitude of 600-1600 metres.

Among the lesser known cattle, but extremely important for Himalayan traders, is the yak, or grunting ox (*Bos poephagus graunieus* Linn). In the wild it inhabits the coldest and most desolate tracts of the Himalayas, from the east to the west, with elevations ranging from 4000-6000 metres. Without the yak, travel and trade in these parts would be as impossible as without the proverbial camel in the desert. According to the 1972 census, there were 43,000 yaks in India.

The yak interbreeds with many types of cattle: bison, banteng, gayal, zebu and European cattle, and has been so interbred for centuries. No interbreeding with buffaloes has been recorded so far in India. Yak bulls are mostly used for cross breeding hill cows. The hybrids are hardier than the yak and are capable of bearing heavier loads, but are inferior in staying power. Hybrids with cattle are now twice the number of purebred yaks. Since there has been no organised effort to preserve this useful animal, its population has declined by almost 25 per cent over the last 10 years.

**Breeding sheep**

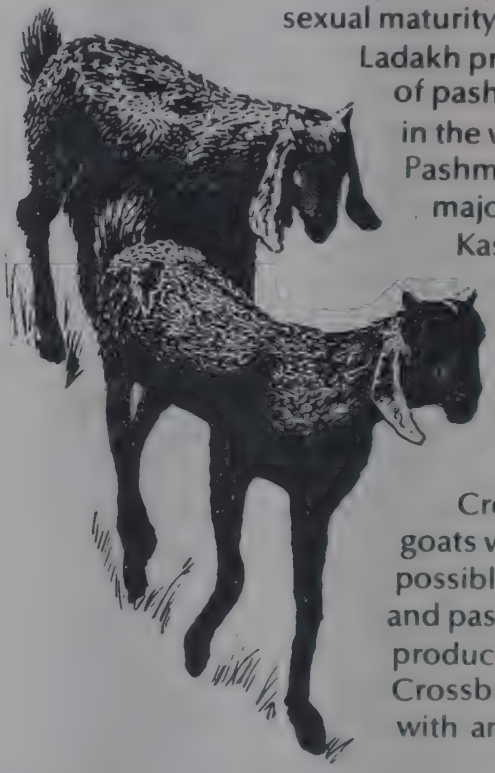
Though sheep are very important in certain regions of India, little work has been undertaken to identify whether any valuable Indian sheep breeds face the danger of extinction.

It may take as much as 25 years before a clear picture of the available genetic material in sheep emerges. Scientists argue that evaluation of indigenous sheep breeds for crossbreeding and their conservation should go hand in hand. It should be mandatory for all sheep development programmes undertaken by state governments to conserve nucleus flocks of breeds used for crossbreeding in their natural habitat.

**Goats**

Like sheep, goats are also important to the Indian rural economy, and as one goat expert puts it, despite regular attempts by soil conservationists to exterminate this animal, its population has been increasing. The origin of Indian goat breeds is not clearly known. They are believed to have been derived from wild goats which inhabited the Asian mountains in antiquity, and to have been domesticated around 7th century BC much earlier than cattle.

There are at present about 17 distinct goat breeds in India, of which several like the Jamnapari are extremely useful. The dwarf goat breeds, such as Black Bengal, Banbari, Malabari and Assam Hill are famous for high prolificacy (multiple births) and early sexual maturity. The Pashmina goats of Ladakh produce the finest quality of pashmina fibre (cashmere) in the world. But though Pashmina goats support a major cottage industry in the Kashmir valley, little is known about them. Research on goats is of recent origin and specific strains are now being developed for milk, meat and fibre. Crossing of Pashmina goats with Angora might make possible a goat with mohair and pashmina. Gaddi, a hill goat, produces hair used for ropes. Crossbreeding of these goats with angoras yields mohair.



**Pigs**

India had only about seven million pigs in 1972 but they are an important source of meat especially for economically disadvantaged groups like Harijans. Traditionally indigenous pigs produced bristles and meat. In fact, meat was only considered a by-product, until the advent of nylon which replaced pig bristles.

There has been no serious attempt to catalogue the various breeds or strains of domisticated pigs in India, and previously unknown varieties are sometimes found. For example, P.N. Bhat recently located a number of strains of dwarf pigs in the northeastern region.

Indigenous pigs can survive under extremely adverse conditions of malnutrition and health. They are reportedly more resistant to disease than exotic breeds. Pigs are receiving greater attention under government programmes and indigenous pigs crossed with exotic breeds are becoming more popular, particularly in central India. Their higher growth potential makes them attractive, but given the adverse circumstances in which they are maintained, the survivability of crossbreds is low, and therefore their advantage is marginal. Because of extensive crossing with the Large White, the indigenous pig in the central region is becoming extinct.

Indigenous breeds need to be properly documented and their performance tested so that proper breeding strategies can be decided. Besides domesticated species, there are several wild ones, such as the common Indian wild boar. The present day pigs have evolved as a result of gradual domestication of wild pigs.

### Camel husbandry

India is one of most important countries as far as camel husbandry is concerned. Its population of 1.1 million camels constitutes about seven per cent of the world total. Camels are found mainly in Rajasthan, Haryana and Punjab, the Arabian one-humped camel being the only species. There are three types of camels found in India: the desert camel, the riverine camel and the hill camel. Bikaneri is the most important desert camel breed in India. Nearly 50 per cent of all Indian camels belong to it. Riverine camels are found in districts of Uttar Pradesh and Punjab, where there is a good water supply. They carry heavy loads and are slow in movement with a speed of 3 km/hour. The desert camel can walk 190 km overnight at a speed of 15km/hour. The hill camel is more compact than the camels in the plains.

The National Commission on Agriculture (NCA) had expressed concern over the changes taking place in the traditional system of camel breeding practised over centuries in Rajasthan. Under the traditional system, camel breeding was undertaken by professional breeders under the patronage of princely rulers and large landlords, who maintained large herds of camel. Excellent camel herds were owned by Bikaner, Jodhpur and Alwar Darbars. In Bikaner, which possessed some of the best camels in the world, camel breeders were given extensive areas for grazing of camels with no tax levied on their grazing. Drinking water from all the wells in the state was allowed free for the animals. Good stud camels called "Mehias" were branded and let loose by individuals interested in camel improvement. These stud camel would move in herds in winter and during the off-breeding season they were free to graze anywhere, without fear of impoundment even if they damaged standing crop.

The traditional camel breeders, with their keen observation, used to breed camels with a definite objective. The camel breeders in Rajasthan evolved distinct types of camels like the Bikaneri and Jaisalmeri. Today, however, the conditions favouring breeding of camels are fast disappearing. Grazing lands have diminished at a rapid rate, having gone under the plough. As a result, most camels breeders are now leading a pecuniary existence with small herds of camels in poor condition. Under these adverse conditions the fine art of breeding has disappeared, reduced to a mere multiplication of stock. "It may not be long before these camel breeders will go completely out of business," warned the NCA.

The NCA was not even sure whether there is a need to make a special endeavour to retain the distinct types of camels that were evolved in the past. "Breeding of animals for genetic improvement without ensuring adequate nutrition is meaningless", it argued. The construction of roads in desert areas is making the animal itself redundant. In the past camels were prized most for their speed of travel and capacity to traverse long distances at a stretch in the desert. In increasing numbers, camels are today being employed for agricultural operations. They played an extremely important role in the construction of the Rajasthan Canal. The survival of the animal, and its various types, is now dependent on whether adequate grazing lands will ever be found for it.

### Horses, ponies, donkeys

India also has about 0.94 million horses and ponies, 0.075 million mules and 0.99 million donkeys. Uttar Pradesh has the greatest number of horses and mules, and Rajasthan of donkeys. Horse breeding has been practised in India for a long time. There are six important breeds of Indian horses and ponies, which include the Kathiawari, one of India's best breeds which is found in Rajasthan and Gujarat; Marwari, which is closely associated with the great feats of bravery attributed to the Rathor kings of Rajputana; Bhutia, which is bred along the Tibetan border and sub-Himalayan tract from Punjab to Darjeeling; Manipuri, which has been bred in Manipur and Assam for many centuries; the Spiti pony of the Spiti Valley; and, the Zanskari horses of Leh in Ladakh.

Donkeys are of two types: the Small Grey, which is commonly found in most parts of the country and the Large White, which is found in the Kutch. Unlike the camel, the donkey has never received much attention. There has been no organised donkey breeding in India even though it is an important work animal. There are no text books or monographs devoted to the donkey, no research on its physiology, productivity or work ability, no selection experiments to increase its performance. Even though next to the camel, it is the best farm animal adapted to a hot, dry environment.

### Poultry development

Chickens constitute over 90 per cent of the total poultry population of India, followed by ducks, six per cent, turkeys and geese, 2 per cent. India and the neighbouring

**As grazing lands disappear, camels and their graziers have nowhere to go. (Smitu Kothari)**

countries have been referred to as the original home of the Red Jungle Fowl *(Gallus gallus)*, from which present day domestic birds are believed to have descended. The Aseel or Malay Fowl is reported to have given rise to all the breeds of poultry. There is evidence to show that these birds, some 2000 years ago, moved through the Middle East to Europe and gave rise to the present day European breeds.

Eighteen types of indigenous breeds are on record. But in number, they are much smaller than exotic breeds. The former number about 50 million as compared to about 100 million of exotic breeds (including crosses). Several indigenous breeds are facing extinction. The original Aseel, a native of Andhra Pradesh, is a medium-sized, round-bodied and well-built bird. However, large specimens have also been bred and developed by the promoters of cock-fighting. The bird is a poor layer but is known for its delicious meat. With the ban on cock-fighting, the Aseel is losing much of its importance, and as a result pure specimens are becoming rare.

The Ghagus is a large sized bird, which is usually found running with the nomads of Karnataka and Andhra Pradesh. It is a hardy breed and is supposed to have resistance to diseases and parasites. Due to neglect, it is gradually becoming extinct.

Information on ducks and other birds is extremely limited. There appears to have been no evaluation of indigenous ducks. At a recent international meeting a scientist expressed concern over government plans to establish breeding farms for exotic Khaki Campbell ducks, both for intensive rearing of these ducks and for upgrading local ducks. There is no specific information as yet that under normal husbandry conditions of limited feed supply and non-existent disease control, the exotics are better than the indigenous birds.

Animal conservation is still a new area even for scientists. With the failure of several animal development programmes in which exotics have been introduced on a large scale or crossed indiscriminately with local breeds, the importance of environmental adaptation using local breeds is being recognised. Hence, the importance of conservation of indigenous breeds to support more appropriate breeding programmes is also acknowledged.

Conservation of animal genes is neither easy nor cheap. It can be done either by maintaining a living herd or flock of animals that need to be conserved, by storage of frozen semen from a representative sample of males or by storage of frozen embryos.

### Export of Frog Legs

Every year Indians kill an estimated 100 million frogs to satisfy the palates of well-fed westerners. The trade, which began in 1959 with the export of 93.5 tonnes of frog legs to Europe and USA, touched a peak of 4368 tonnes in 1981. Over half of this amount went to EEC (European Economic Community) countries, of which Netherlands, the largest buyer, alone accounted for 1700 tonnes. Of late, frog legs from India have also been finding their way into Canada, Saudi Arabia, Japan and the United Arab Emirates.

Frogs for export are collected mainly from areas in and around Calcutta, Hyderabad and Cochin. As legs account for just about one-third of the body weight of the frog, the 1981 trade figure means that some 9000 tonnes of frogs were killed in that year. This figure does not include the vast number of frogs that die after being collected and during transport to the processing factories.

While the country earned Rs 12 crore in foreign exchange in 1981 about 12 per cent of India's marine product exports, ecological destruction caused by this trade, probably meant greater expenditure on insecticides and losses in crop production. As the Indian bullfrog *(Rana tigrina)* eats its own body weight in insect pests every day, the 9000 odd tonnes of insects and mosquitoes that survived because of the decimation of frogs caused many plant diseases and probably even cases of human diseases like malaria and encephalitis. Depleting the frog population results in the proliferation of dangerous crop pests like the rice stem borer which seriously damages crops. The frogs most affected by the trade are the two most common species, *Rana tigrina* and *Rana hexadactyla*.

Concerned by the destruction of frogs and its effect on crops, the Indian Council of Agricultural Research commissioned the Bombay Natural History Society for a three-year study. It concluded that the capture of frogs for commercial purposes should be banned.

In discussion with foreign scientists, former Prime Minister Morarji Desai had agreed to ban the frog legs trade, just as he had banned the trade in monkeys. But when the matter was taken up by the Indian Board for Wildlife in October 1983, the Department of Environment, bowing to the wishes of the Ministry of Commerce, refused to support conservationist Arjan Singh's demand for a total ban. The Commerce Ministry argued that it had already reduced the export quota for 1983-84 to 90 per cent of the 1981 figure, that is, 3658 tonnes, and India's falling exports had been picked up by other Asian and Latin American countries.

The Department of Environment contended that it had placed the *Rana* species in Schedule IV of the Wildlife (Protection) Act. Licenses have to be obtained for trapping and dealing in *Rana* species. Wildlife wardens have been asked to consider ecological implications carefully before granting licenses. Trapping of frogs between April 15 and August 15, the breeding season, and processing and export of frog legs between June 15 and August 15 have been banned.

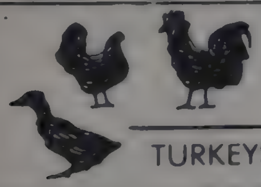
Besides the Ministry of Commerce, which is keen to earn foreign exchange from exports of marine products, the frog catchers, too, are unhappy over the proposed ban of the trade. In December 1982, members of the Kerala Thavala Thozhilali Congress (Kerala Frog Catcher's Association) organised a noisy demonstration in front of the government secretariat in Trivandrum against the restrictions on their nocturnal occupation.

The Trivandrum protest, accompanied with croaking frogs, however, only helped to focus national attention on the plight of frogs. Frog catching is an extremely cruel exercise. In a typical operation, teams of four or five people will move out after dark armed with sacks and petromax lamps. In an area like Kuttanad in Kerala, thousands of frogs can die in one night. The actual catching is usually not difficult. The frog is petrified by the light of the petromax lamp and is easily picked up and stuffed into a sack. Crammed together throughout the long journey to the processing units, many frogs die on the way. Survivors only live to get their hind legs severed and dumped alive in a bloody basket. The basket is periodically dumped on the roadside to make a feast for vultures and a stench for passersby. The 150 km stretch of National Highway 47 between Cochin and Alleppey often stinks because of dismembered frog bodies on the roadside.

The battle for humanity in dealing with frogs still remains to be won. The Department of Environment suggests breeding frogs in captivity for export instead of catching frogs from the wild. But frog catchers and exporters prefer to get them from the wild as this is much cheaper.

In India the need to conserve animal genetic resources is being recognised, Several institutes concerned with preserving animal genetic resources have been set up. They

**Domesticated animals in India**

| | | Average 1969–71 (millions) | 1981 (millions |
|---|---|---|---|
| | HORSES | 1.010 | 0.760 |
| | MULES | 0.084 | 0.128 |
| | ASSES | 1.000 | 1.000 |
| | CAMELS | 1.110 | 1.150 |
| | PIGS | 6.207 | 10.200 |
| | SHEEP | 40.657 | 41.500 |
| | GOATS | 66.529 | 72.144 |
|  | CHICKEN | 127.333 | 147.000 |
| | DUCKS | 6.697[2] | — |
| | TURKEYS AND GEESE | 1.843[2] | — |

(1) All data for 1981 is based on FAO estimates.

(2) Data relates to 1961 from 1961 census, Directorate of Economics and Statistics, Ministry of Food and Agriculture, New Delhi.

are the National Bureau of Animal Genetic Resources (NBAGR) a National Centre for Studies on the Mithun in Arunachal Pradesh, a National Institute for Research on Goats in Mathura district, Uttar Pradesh and a breeding farm for camels at Bikaner. An enormous amount of work is needed to document and evaluate indigenous breeds of birds and animals and then based on this information, urgent action taken to conserve breeds.

## Fish genetic resources

Though India has a rich variety of fish fauna, only a few species have ever been cultivated. The most important among these are the carps including *Catla catla*, *Labeo rohita*, *Cirrhinus mrigala*, *Labeo calbasu* and a few others. Several exotic species have also been introduced into India (the Chinese carps, tilapia, trouts, gourami, etc).

The natural habitats of the cultivated species are the major rivers where they breed naturally. Under aquaculture, however, though they mature in ponds, they normally do not breed there. Fish seed, therefore, has to be collected from the rivers for aquaculture. As it is being practised today, this will have a detrimental effect on fish and may leave a genetically depreciated stock in the natural habitat.

Since fish species inhabit different ecological systems in geographically and climatically isolated areas, it is possible some of these species could have evolved into definite strains having various advantageous characteristics. Unfortunately, no comprehensive study has been made so far even on these few cultivated fish.

### Inbreeding of fish

Intensive aquaculture through genetic selection and selective breeding result in the species becoming more inbred and with less genetic diversity. Though aquaculture work in India is still limited, original diversity could be eroded in future. Thus to maintain the genetic diversity for present and future requirements, conservation of genetic resources in fish is essential.

Several dams and canals are being built to harness the country's water resources. They can have serious implications for fish genetic resources by permitting inter mixing and breeding of different strains and species which hitherto enjoyed isolation and preservation in different geographical and ecological boundaries.

Transmittance of undesirable species to areas where they are not liked or which may compete for food, space and breeding with local varieties; introduction of fish predators and various other organisms; introduction of fish parasites and dangerous pathogens to areas where they were not known before; and, spreading of undesirable and harmful aquatic weeds are some of the more obvious possibilities.

In the case of crop genetic resources, after exploration, varieties are conserved in a central pool. Thus at any given time the required strain is available from a central place. But maintenance of fish at a central pool for a number of years can be hazardous as there can be complete loss of a precious variety through disease and other unfavourable factors. Furthermore, maintenance of certain strains over decades in ponds and repeated breeding will result in partial or complete domestication of the species. This is contrary to the idea of conserving genetic resources.

The best way is to protect these varieties in their natural habitat. This needs legislation to declare certain natural habitats protected and free from fishing; preventing pollution of the protected zone; preventing construction of dams weirs in these protected zones or if dams and weirs are constructed, suitable and effective provisions for fish movements will have to be incorporated; preventing interlinking of various major drainage systems; protecting fish breeding areas in natural habitats; and, restricting large-scale exploitation of fish seed from riverine sources.

The Indian Council of Agricultural Research (ICAR) has recently established a working party on conservation of genetic resources of fish to consider all aspects of this problem. But this constitutes little more than a beginning of the understanding of the problem.

## Tree genetic resources

Large areas of forests are in imminent danger of disappearing. Although there is little risk of entire species of trees becoming extinct, populations at the limit of the species range or in isolated blocks of forests are definitely vulnerable. Often these small populations have a high frequency of valuable genes—for drought resistance, for example—which could be used in future tree breeding programmes.

Tree genetic resources have been neglected in the past. With a growing interest in forestry across the world now, it has become essential to preserve the natural wealth in trees. South Korea, which has carried out the most extensive afforestation in Asia, has set up an entire research institute devoted to tree genetic resources and development of suitable trees.

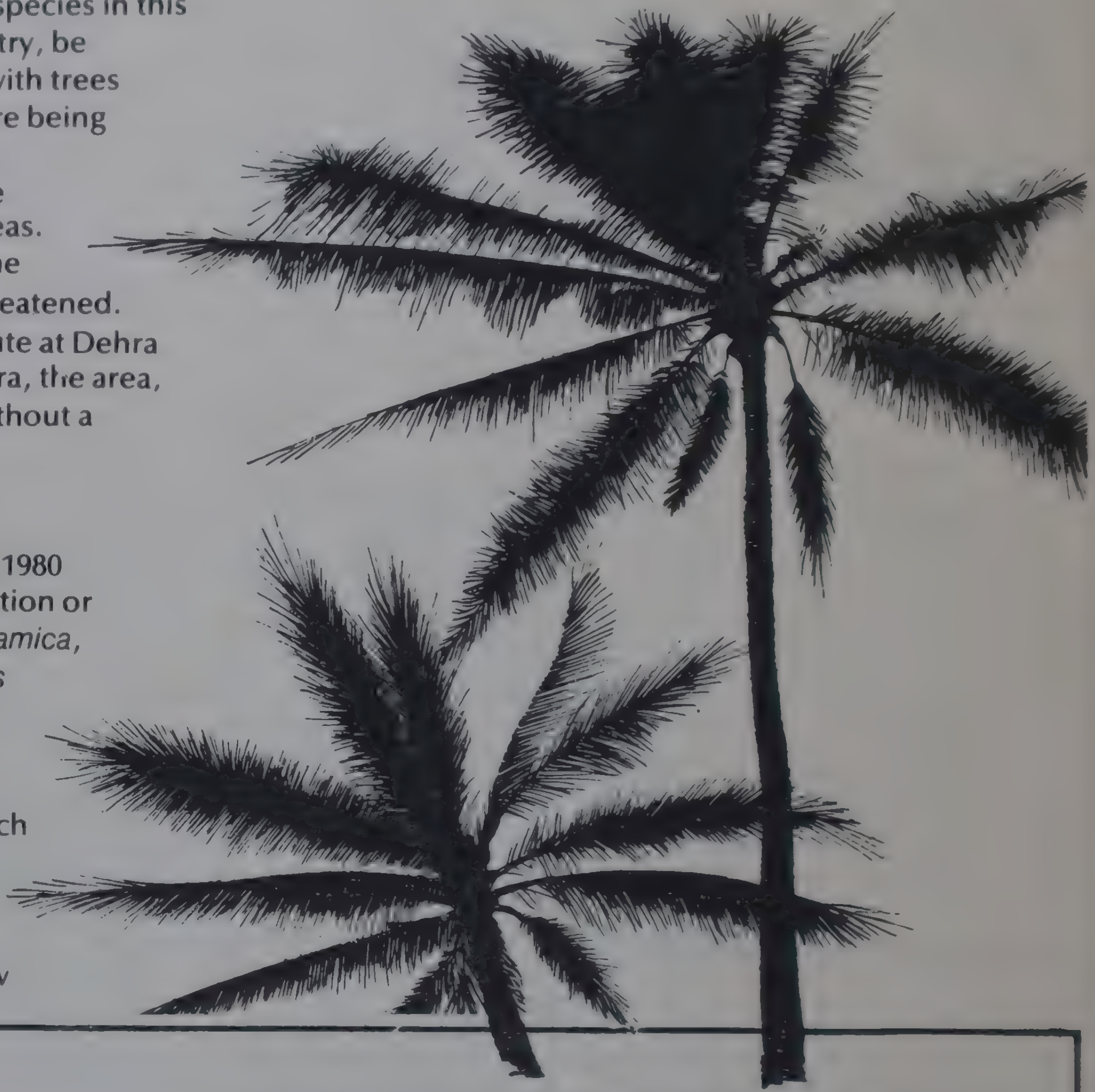
Tree populations are most threatened in arid and semi-arid areas where an intense pressure exists because of the demand for firewood. Developments in commercial forestry have put immense pressure on specific trees which have acquired an economic value. The Dang forests in Gujarat, for instance, are a rich reservoir of a number of plant species which were not considered of economic value about 20 years ago. Good examples of these species are kakad (*Garuga pinnata*), which is used for pulp and packing cases, tanch (*Ougeinia oojeinensis*) used for making agricultural implements, haldu (*Adina cordifolia*) and kalam (*Mitragyna parvifolia*) used for making bobbins and furniture, and modad (*Lannea grandis*) and kudi (*Wrightia tinotoria*) used for making toys. It is important that tree species in this area, as in many other forest areas of the country, be preserved. Equally, several village woodlots, with trees representing well-adapted genetic material, are being steadily depleted. FAO wants to give priority to collecting the diversity in tree species suitable for firewood and fodder production in dry areas.

Arunachal Pradesh is another area where the richness in tree resources is being steadily threatened. As two scientists of the Forest Research Institute at Dehra Dun put it: "In spite of the richness of the flora, the area, to this date, remains a terra incognita and without a comprehensive published flora."

**Depleting species**

A paper published in "The Indian Forester" in 1980 listed about 20 species facing danger of extinction or depletion. This list includes *Phyllostachys assamica*, a bamboo used for making huts, *Gymnocladus assamicus*, a small tree which grows up to 20 metres high and whose fleshy pods are used for washing hair as a substitute for soap, and the spectacular *Rhododendron dalhousiae* which has cream colour flowers with purple bands. *R. dalhousiae* is such a beautiful plant that it was awarded a First Class Certificate by the Royal Horticultural Society in the UK. It is now facing extinction owing to massive road building and developmental activities in Arunachal Pradesh.

Tree genetic resources can be conserved either *in situ* or *ex situ*. Conserving *in situ*, that is, preserving the entire ecosystem together with its trees, is definitely more desirable but often extremely difficult and expensive. When effective *in situ* conservation is not possible, trees have to be conserved in artificial stands established *ex situ* in their country of origin or elsewhere.



## All the World's Coconuts

The coconut tree is an extremely valuable tree. It yields not only cooking oil but also food, fuel, coir and wood for building.

In their desperate bid to stop diseases, scientists in India have been injecting tetracycline into coconut trees, but with little effect. Plant diseases, many of unknown origin, are afflicting nearly 30 per cent of the area under coconut plantations in the country. The annual loss is estimated to be 300 million nuts worth about Rs 700 million. This colossal waste of coconuts has come at a time when there is a general shortage of vegetable oil.

Amongst trees, coconut is affected by a surprisingly large number of diseases (about 25), all of which are baffling researchers the world over. The root wilt disease of Kerala (a debilitating disease comparable to tuberculosis in humans is a major killer.

A large number of coconut varieties are becoming extinct because of the havoc created by such diseases. This erosion of the coconut "genetic stock" in nature has led to worldwide concern. It is important to preserve all these varieties to breed new and better varieties for future plantations. Leading coconut growing areas of the world like the West Indies and the Philippines are already planting hybrid varieties for increasing productivity of coconut plantations.

"There is a need to internationalise this research effort," says Dr N.M.Nayar, the director of the Central Plantation Crops Research Institute (CPCRI) located at Kasaragod in Kerala. The institute, with 65 years of experience in coconut research, is going ahead with a plan to create a world coconut germplasm centre in the Andaman Islands to collect, preserve and breed most of the world's coconut varieties. In 1981, three Indian scientists went on a tour of Papua New Guinea and various Pacific islands like the Solomon Islands, New Caledonia, Fiji, Tonga, Samoa, and Tahiti. Four thousand seedlings of different varieties of coconut trees were collected.

The Institute proposes to raise these seedlings off the Wandoor coast, 20 km from Port Blair in the Andaman and Nicobar Islands. The Tarmugli island, 5 km away from the infrastructure, still has to be built. "The Andamans are a natural coconut growing area and, hence, ideal for a coconut research centre," Dr Nayar points out.

Additional funds are being sought from the United Nations to send similar expeditions to other Pacific islands and coconut growing areas of the world.

By using these different varieties of coconut trees, scientists hope to breed not only new coconut plants which are immune to plant disease but also plants with higher productivity, more sugar content, rapid maturity and other desirable qualities.

There is a strong need for more collaboration in coconut research, argues Dr Nayar. Isolated national projects have all yielded good results. But a coordinated international effort in evolving new coconut strains would be a better approach.

*In situ* conservation of tree genetic resources has been practised in India through the system of "preservation plots". The first preservation plot was set up in the sal forests of Bihar in 1906. Some 188 plots have been established since then to protect mainly commercial species like *Shorea robusta* (sal), *Tectona grandis* (teak), and various conifers. Most of these plots cover natural forest types and range from a few hectares to 4000 ha. Preservation plots in plantations are small. The coverage of these plots is also patchy. Many forest types like southern tropical forests, semi-evergreen forests, and tropical thorn forest need particular attention.

A beginning is being made in the preservation of trees important for social forestry. Leguminous shrubs which can enrich soil fertility through biological nitrogen fixation and at the same time provide food, fuel and fodder are particularly worthy of greater attention. Leucaena is already receiving worldwide attention. Several international conferences have recommended the collection and conservation of casuarina and neem germplasm. Two conferences held on neem in West Germany in recent years have pointed out that the potential for improvement of the neem tree in yield and quality characteristics is considerable.

India is participating in an international project to collect tree species used in arid and semi-arid areas. According to the list of priority species that has been prepared for this project, first priority will be given in India to three indigenous species (*Acacia nilotica*, *Acacia senegal* and *Prosopis cineraria*) and several exotic species of acacia, prosopis, eucalyptus, and leucaena. Among the second priority indigenous species are *Albizzia lebbek*, *Pongamia pinnata* (karanj) and *Azadirachta indica* (neem). Among exotics given second priority is *Prosopis juliflora*, which was introduced into India nearly a century ago but which is now widespread and shows considerable variation of form. Indigenous species listed for future consideration are *Hardwickia binata*, *Kingiodendron pinnatum* and *Dendrocalamus strictus* (bamboo).

## PEOPLE Vs SANCTUARIES

Belatedly, conservationists have recognised the need to set aside land to preserve India's fast diminishing wildlife. There are now 45 National Parks and 211 sanctuaries in the country—covering over 9 million hectares, that is, 3 per cent of the country's total land area. and 12 per cent of the area controlled by the forest departments. The human inhabitants eke out an existence by growing fodder, grazing cattle or collecting forest produce, and they are mainly tribals.

Until a decade ago, India's wildlife—symbolised by the majestic tiger—was being threatened by human intervention of various kinds. Now the wheel seems to have turned full circle: tigers, thanks to better protection, are posing a grave danger to people living around wildlife sanctuaries. This grim turn of events, where the hunted has become the hunter, only serves to illustrate a larger dilemma: are sanctuaries supposed to be the preserve of their fauna, to the exclusion of humans ?

The tiger "success story" is held up as probably the most spectacular conservation victory of all time in the world. When Project Tiger was launched in 1973 by the Indian

**When only prized animals, like this gaur, are protected, the hunted become the hunter. (FAO)**

## People and Sanctuaries

**A Rejoinder by Bittu Sahgal, editor of Sanctuary**

The very idea of 'People vs Sanctuaries' is downright absurd. Incontrovertible evidence exists linking the health of farmland to the existence of forest land. Climate, soil conservation and fresh water availability are being adversely affected on account of the depletion of forest cover. Ideally, experts say, one-third of the Indian subcontinent should remain under forests to ensure that the remaining two-thirds is able to support the millions of humans who live there. But official estimates say that India's effective forest acreage is less than 12 per cent of its land mass and unofficial sources place the actual figure at less than 9 per cent and shrinking!

Nevertheless, the human-tiger conflict is a reality and has been one ever since humans ventured into forests in search of sustenance. However, the incidence of human-eating has actually been reduced since the days of Jim Corbett. Protecting selected habitats to ensure an adequate prey base and more important, prevention of human intrusion into forests can be seen as the reasons for reduced human-eating incidents. For this, Project Tiger must get its due share of credit as tiger reserves are the only large scale wilderness areas in the country where the principle of 'nature knows best' is being accepted and followed.

It must be noted that the people vs sanctuaries argument is often a cloak for other ends. The cattle lobby too often exhort hundreds of villagers to graze animals belonging to a rich handful, thus thwarting protection plans with the excuse of villager's rights. In the process, sticks and stones hurled at tigers which attack livestock lead them to turn on the graziers with tragic results. The timber lobby is also vociferous in proclaiming that stoppage of wood cutting affects villagers' rights. Plans for major hydel projects, however, are enthusiatically supported by paper and timber units. Clear felling trees in proposed catchment areas, at the eventual cost of the local populace, is the ultimate objective.

The problem should be phrased people and sanctuaries, not people vs sanctuaries. Protection is the only method if any semblance of genetic diversity is to be retained for future generations. If villagers are now allowed to walk into protected reserves and collect 'just a little' timber, or graze 'just a few' head of cattle, the sanctuaries too will become like the semi-arid lands that now surround so many human habitations. There is no magic wand. Social workers must convince local leaders that some people, notably those who live close to forests, will have to give up some of their current rights so that the majority can survive into the future. Conservationists will have to accept the wisdom of reducing hostility around sanctuaries and parks by distributing whatever jobs and opportunities are available to tribals and local people. Compensations for lost lives or property must reach the actual sufferer. Here social workers can act as watchdogs and represent local people against known manipulators.

Project Tiger managers have worked out a system of core areas and buffer areas to reduce the chances of human-animal conflicts. The buffer zones, unfortunately, are grossly misused. With the connivance of local toughs and vote-hungry politicians people persistently enter these areas and some, in fact, lured by the money to be gained from forest produce and poaching have tried to move into buffer zones. This disturbs the animals and magnifies the possibility of conflict.

Bandhavgarh is a classic example. Local politicians and other vested interests have opposed the expansion plan from 105 sq km to 448 sq km tooth and nail. Such an expansion would certainly serve to reduce human-animal conflicts, but would eat into the coffers of those who casually exploit the forest. In Dudhwa, Billy Arjan Singh has been crying himself hoarse about the danger of planting sugarcane adjacent to the forest. He suggests alternative crops, not that farmers should be moved. Sugarcane fields lie undisturbed for months and tigresses find them ideal spots to lay their litters. At cutting time a surprised, angry and protective mother kills the unfortunate human whom she sees not as food but as a threat to her young.

As for the Sunderbans, there can be no denying that the reserve has a human-eating problem. There are now over 200 tigers here and roughly 200 reports of human killing surface each year. The authorities have been instructed to execute proven human-eaters, as they have been instructed to do anywhere in India. This is as it should be. Stories, however, are legend in West Bengal of tigers becoming scapegoats for dowry deaths, family feuds, or even to avoid returning money to money lenders who conveniently get eaten by tigers when loans fall due.

The crux of conservation is the fact that the environment must be protected for the long term benefits of humans. Termites and tigers possess the 'know how' to enable wild habitats to survive. The absolute poor of the Indian subcontinent, like the animals and birds of the forest, are directly dependent on the land, and their salvation lies in restoring health to the land. Despatching tigers to zoos or to their graves, far from helping humans, would only make things worse.

## 'Kill the Tigers'

In late 1982, S.A.H.A.A. Imam, a professional big-game hunter, dragged in the Supreme Court to decide the fate of the tigers of Sundarbans. Imam argues that in the famous Sundarbans Tiger Reserve, where the density of tigers is extremely high (one tiger per 6.5 sq km), all the 200-odd tigers are humaneaters or potential humaneaters. The forests are dense, visibility is poor, and huge tracts get swamped by tides twice everyday reducing the effective land area to less than a third. Tigers kill 42 to 63 human beings every year in Sundarbans.

The Wildlife (Protection) Act of 1972, which makes the tiger a protected species, also enjoins the chief wildlife wardens to declare for destruction of a protected animal, when the animal is a threat to human life. Read together with the sections of the Indian Penal Code, Imam argues that if chief wildlife wardens do not do everything possible within their power for the elimination of a humaneater, charges of murder and of culpable homicide can be levied against them.

One result of this writ petition is that the Indian Board of Wildlife has withdrawn its recent guidelines directing wildlife wardens that humaneaters should as far as possible be tranquilised and not shot. But Imam's plea that all tigers of Sundarbans should be shot because of their potential threat to humans has yet to obtain a judicial verdict.

Conservationists are obviously up in arms. H.S. Pawar, director, Project Tiger does not agree that all Sundarbans tigers are humaneaters. Says Ashish Kothari of Kalpvriksha, a voluntary group in Delhi: "By no stretch of imagination (except Imam's) is conservation a new phenomenon in India. Humaneaters in some areas like Sundarbans and Dudhwa have caused great suffering. Some officials have not done their duty regarding these humaneaters. An eastablished humaneater must immediately be shot or captured. But there are several moral and ethical arguments too. If we cry out against the suffering caused to human beings by marauding wild animals, must we not also protest as vehemently against the torture inflicted by human on animals?"

government (with the assistance of the International Union for Conservation of Nature and the World Wildlife Fund), there were only 1827 of the striped beasts in the entire country. At the turn of the century, by contrast, there were an estimated 40,000. Today, there are 15 specially protected parks under Project Tiger out of a total of 243 wildlife sanctuaries and national parks covering an area of 2.5 million hectares (equivalent to 3.2 per cent of the forest area and 0.77 per cent of the total geographical area) and the number of tigers has crept up to 3015 (1979 census).

Perhaps the tiger bulge is most apparent in a tiny sanctuary like Bandhavgarh national park, about 250 km from Khajuraho in Madhya Pradesh (in a national park, all forestry operations are banned in the core area, unlike in other sanctuaries). It has as many as 22 tigers in 110 sq km; when the first national tiger census was conducted in 1972, there were just nine.

Each tiger is said to require at least 15 sq km of land and there should be plenty of herbivores for it to feed on. Bandhavgarh's tiger population can no longer be contained within the sanctuary; a tiger kills every five days, on average, and this means 70 herbivores per year. With 22 tigers in the park, this calls for a minimum of 1500 herbivores. And yet the number of chital (spotted deer), the most common in the park, is only 1000 and on the decline.

**Tigers and people**

With this "predation pressure", as MP's Chief Wildlife Warden J J Dutta terms it, it is not surprising that the tigers of Bandhavgarh have started stirring out of the park and turned their attention to cattle and, on occasion, people. Between 1981 and 1982, there have been at least three fatal attacks by tigers. The last occurred in May, when a Baiga tribal was killed when he stooped to pick some tendu berries just on the periphery of the sanctuary. According to Ranjitsinh, former Madhya Pradesh Forest Secretary and a well-known wildlife enthusiast himself, there was a tiger in Bandhavgarh that summer which did not touch his first human victim, nibbled the second, ate the third and fourth and was shot dead after the monsoon. In all probability, it was the same which killed the tribal.

Between 1979 and 1981, 1383 heads of cattle in villages surrounding Bandhavgarh have been killed by tigers, which works out to more than an animal a day. The state government pays compensation of up to Rs 2000 per head, but in fact this works out to an average of Rs 400. In other words, the government pays by way of compensation about one-third of what it spends on conservation every year. If a person is killed outside the park, the family is paid Rs 5000—as was the case of the Baiga tribal in May 1982; within, there is no compensation since humans are forbidden from entering. The penalty for shooting a tiger is a mandatory six months in jail and a fine of up to Rs 2000 or both. The maximum sentence can extend up to six years.

The situation is even worse in the Corbett National Park, where Prime Minister Indira Gandhi launched Project Tiger in April 1973. From 44 in 1972, there are now 91 tigers in an area of 480 sq km. Chandra Bhan Singh, the park's field director, admitted recently: "Things are getting a bit crowded here. Ideally, I would like between 75 to 80 tigers. We have to find a way of stabilising the population rise, otherwise things could get out of hand."

Many villagers in the surrounding areas would claim that such a situation already exists. In March last year, tourists found a severed paw of a tigress in the park. Investigations by park officials later revealed that the tigress was a victim of another which had not only mutilated her badly but eaten large chunks of her carcass as well. Wildlife enthusiasts, however, dismiss such instances by pointing out that cannibalism is common in the animal world. Bittu Sahgal, editor of "Sanctuary" magazine, writes: "This merely demonstrates nature's age-old method for controlling the population of animals in a given range."

Nevertheless, some 2000 villagers on the outskirts of Corbett Park fear for their lives. In the last two years, 20 persons are reported to have been killed by the beasts and the villagers complain that ever since Project Tiger was launched, tigers seem to have lost their age-old fear of humans. In 1981, a humaneater in an area of the park called Banga killed three persons before it was trapped and sent to the zoo in Lucknow.

Things are no better in the neighbouring Dudhwa National Park (not under Project Tiger), where tigers prowl around tourist rest houses and have lifted villagers from within 20 paces of their homes. In the past three years, 125 people have been killed there. Unlike Corbett, Dudhwa does not have a large buffer area; thousands of people living directly next to it cultivate sugarcane which provides a ready refuge for the striped cat (it has even been known to litter in the tall crop).

**Land under protection**

| State/ Union Territory | % of total land area under wildlife sanctuaries. |
|---|---|
| Chandigarh | 18.00 |
| Sikkim | 11.6 |
| Goa | 9.52 |
| Karnataka | 5.00 |
| Kerala | 4.6 |
| Himachal Pradesh | 3.56 |
| Gujarat | 3.5 |
| Andhra Pradesh | 3.3 |
| Orissa | 3.04 |
| Bihar | 2.8 |
| West Bengal | 2.3 |
| Uttar Pradesh | 1.9 |
| Rajasthan | 1.87 |
| Tamil Nadu | 1.6 |
| Assam | 1.53 |
| Madhya Pradesh | 1.28 |
| Nagaland | 1.28 |
| Maharashtra | 1.00 |
| Mizoram | 0.8 |
| Haryana | 0.73 |
| Manipur | 0.46 |
| Jammu and Kashmir | 0.36 |
| Andamans | 0.24 |
| Punjab | 0.08 |
| Meghalaya | 0.02 |
| Dadra and Nagar Haveli | – |
| Delhi | – |
| Lakshadweep | – |
| Pondicherry | – |

Source: Wildlife in India, Department of Agriculture, Ministry of Agriculture, 1981

## Extent of nature protection in India

Biogeographers—experts interested in identifying biological diversity across the world—have divided the geographical area of the globe (land and freshwater bodies) into eight biogeographical realms. A realm is a continent or subcontinent sized area with unifying features of geography and fauna, flora and vegetation. Most of India is covered by the Indomalayan realm, except for parts of the Himalayan region which fall in the Palaearctic realm. The realms are further divided into a total of 193 biogeographic provinces, whose boundaries are drawn according to significant differences in flora, fauna and vegetation structure. India is divided into a total 12 provinces. While the geographical area is divided into realms and provinces, the world's ecological communities of plants and animals are broken up into 14 major biomes. Each province consists of one biome. In India, we find four major biomes: mixed mountain systems, tropical humid forests, tropical dry forests/woodlands, and warm deserts/semi-deserts.

When planning for nature protection areas, national authorities are expected to give adequate coverage to each of the biogeographical provinces found in the country. Minimum coverage expected for each province is 100,000 hectares and in the case of an oceanic island, it is 10,000 hectares. The only biogeographic province in India which did not have any protected area until 1981 was Laccadive Islands and the provinces of the Coromandel Coast and Andaman and Nicobar Islands were still not adequately covered.

An expert committee set up by the Indian Board of Wildlife, in its report submitted in 1970, recommended that at least four per cent of the total land area of the country should be under nature reserves. Many countries of the world have already declared nearly 10 per cent of their land area as protected areas. There will definitely be international pressure from conservationists that India, too, reach such a figure. Sikkim had already brought over 10 per cent of its land area under the protected category by 1982. There will also be pressure on India to intensify the management of its protected areas. Many sanctuaries have already been converted to national parks where tourists are allowed but no grazing is permitted as compared to wildlife sanctuaries where limited grazing is tolerated. In 1982, India had about 860,000 hectares under 22 national parks and about 8,300,000 hectares under 184 wildlife sanctuaries. The number of national parks has now gone up to 32 and of wildlife sanctuaries to 211. India is also planning to set up biosphere reserves, where management will be even more strict.

### Major National Parks/Wildlife Sanctuaries in different Biogeographical Provinces

| Biogeographical province | Area (hectares) |
|---|---|
| **A TROPICAL DRY FORESTS/WOODLANDS** | |
| 1. INDUS-GANGES MONSOON FOREST | 3,567,182 |
| Kanha NP, Madhya Pradesh | |
| Corbett NP, Uttar Pradesh | |
| Dudwa NP, Uttar Pradesh | |
| Great Indian Bustard WS, Maharashtra | |
| Chambal WS, Uttar Pradesh | |
| 2. BURMA MONSOON FOREST | 2,98,009 |
| Kaziranga NP, Assam | |
| Pakkui WS, Arunachal Pradesh | |
| 3. MAHANADIAN | 1,087,681 |
| Nagarjunasagar-Srisailam WS, Andhra Pradesh | |
| Chilka WS, Orissa | |
| 4. COROMANDEL | 53,451 |
| Pulicat WS, Andhra Pradesh | |
| 5. DECCAN THORN FOREST | 420,451 |
| Bandipur NP, Karnataka | |
| Bannarghatta NP, Karnataka | |
| Dandeli WS, Karnataka | |
| Someshwara WS, Karnataka | |
| **B WARM DESERTS/SEMIDESERTS** | |
| 1. THAR DESERT | 1,005,982 |
| Gir Lion NP, Gujarat | |
| Gulf of Kutch Marine NP, Gujarat | |
| Velavadar NP, Gujarat | |
| Wild Ass WS, Gujarat | |
| Desert WS, Rajasthan | |
| **C MIXED MOUNTAIN SYSTEMS** | |
| 1. HIMALAYAN HIGHLANDS | 524,460 |
| Sanjay Gandhi NP | |
| Kedarnath WS, Uttar Pradesh | |
| Govind Pashu Vihar WS, Uttar Pradesh | |
| Khangchendzena NP, Sikkim | |
| 2. SZECHWAN HIGHLANDS | 180,782 |
| Namdnapa WS, Arunachal Pradesh | |
| **D ANDAMANS AND NICOBAR ISLANDS** | 2,000 |
| Barren Islands WS | |
| Narchondam islands WS | |
| North Reef Islands WS | |
| South Sentinel Islands WS | |
| **E TROPICAL HUMID FORESTS** | |
| 1. MALABAR RAINFOREST | 1,527,009 |
| Eravikulam Rajmallay NP, Kerala | |
| Borivli NP, Maharashtra | |
| Vansda NP, Gujarat | |
| Anaimalai WS, Tamil Nadu | |
| Wynad WS, Kerala | |
| Periyar WS, Kerala | |
| 2. BENGALIAN RAINFOREST | 334,703 |
| Sundarbans Tiger Reserve West Bengal | |
| Sajnakhali WS, West Bengal | |

Note: NP: National Park WS: Wildlife Sanctuary

Source: IUCN, 1982 UN List of National Parks and Protected Areas, Gland, 1982

Ghana bird sanctuary at Bharatpur, six people were killed in November 1982 when the police opened fire on graziers who were demonstrating against a ban imposed the previous year on buffaloes entering the marshy area. While environmentalists are themselves divided on whether the buffaloes damage the fragile ecosystem of the sanctuary which harbours some 250,000 migratory and other birds, all agree that the police over-reacted in this case (see box). In the Similipal Project Tiger Park, 141 tribals were arrested in 1980 when police swooped down on a traditional mass hunt conducted with bows and arrows.

### Critics of conservation

Today, the battlelines between the conservationists and their critics are fairly clearly drawn. The former are anxious to demonstrate that they are not "tiger-crazy". Kailash Sankhala, the first field director of Project Tiger (and author of the well-researched book, "Tiger!") says: "The tiger is only an index of environmental quality. He does not stay to eat the last deer, but leaves the area before the final stages of deterioration take place." Bittu Sahgal adds: "To induce tigers to propagate, natural prey such as deer and wild boar had to be made available. These in turn needed grass, trees

### While Firing takes place in Bharatpur . . .

On November 7, 1982, police opened fire at the Keoladeo Ghana National Park at Bharatpur, killing six people (unofficially seven). A few days earlier, district authorities had met the sarpanch of Aghapur village, home of most of the victims, to tell him that the sanctuary's Aghapur gate would be closed from November 7 and grazing in the national park banned. The villagers decided that something had to be done. Unfortunately, passions ran high on both sides, provoking the tragedy.

There are conflicting reports on what happened. The police claim that the villagers burst through the gate with cattle, assaulting a forest guard, and stoned forest staff and police, upon which the police opened fire though they say they aimed only at the legs. Investigations reveal, however, that there was no evidence of stonethrowing at the site, the supposedly injured police and forest guards did not go to hospital, many villagers were hit in the back—obviously as they tried to flee—and the tractor trolley carting the wounded was detained by the police for several hours. One person died on the spot, say the villagers, and five on the way to the hospital. Twenty-seven were arrested for attempt to murder.

The Bharatpur incident illustrates the growing tension between wildlife guardians and those who depend on the protected area for their living. The 2,200 hectare sanctuary harbours over 350 bird species—new ones are added every year—and 120 species nest in the park area. But some 4,000 head of cattle from 14 surrounding villages also fed on its grass and villagers were even charged Rs 16 per buffalo and Rs 8 per cow, earning the park authorities between Rs 60,000 and Rs 80,000 a year.

The forest was first declared a sanctuary in 1956. In 1972, the Bharatpur maharaja's hunting rights were withdrawn when the Wildlife (Protection) Act was passed: the villager-forest guard conflict began this year. Grazing was banned when the sanctuary became a national park, but the status quo was maintained for about a year until October 1982 when the matter came up before the Indian Board for Wildlife. The state government decided to stop grazing from November 1, 1983 and a week later half-a-dozen villagers lay dead.

Local forest officials argued that animal husbandry was not the primary occupation of the majority of the graziers and that only 119 people from surrounding villages who grazed cattle in the park owned less than 5 bighas. The villagers retort that the park was the only fodder source, especially during the lean dry season. In Aghapur village, because of waterlogging, marginal farmers can cultivate only 2 to 4 bighas and depend on the sale of milk for their livelihood, as most of the year they cannot afford fodder. Steps taken to stop grazing will directly affect these people.

The irony is that the effect of grazing on the park's ecosystem is not clear. A Bombay Natural History Society researcher feels that grazing is healthy—droppings are good fertiliser, forest fires are prevented when animals eat up dry grass, weeds are checked and insects, food for birds, breed in the droppings. Several birds have also been found to nest in the deep footmarks of the animals. It is possible that the authorities have been too hasty in sealing off the birds' preserve, just as the police were too quick on the draw.

### . . . Resentment festers in the Valley of Flowers

On September 20, 1983, an ugly confrontation took place between the police and the villagers of the Bhyundar Valley, which leads on to the world famous Valley of Flowers in the Garhwal Himalayas. The villagers wanted to establish an image of Hanuman on the road leading to the Valley of Flowers which together with its associated areas has been declared a national park. The police tried to confiscate the image. Fortunately, timely intervention by the local subdivisional magistrate stopped them.

The incident once again illustrates the resentment of local people at the usurpation of their traditional rights. The people in this case have good cause for complaint, for conservation is rooted in their tradition. In winter, residents of Bhyundar village move to Pulna village in the lower part of the valley, passing through the Valley of Flowers with their sheep and goats, collecting medicinal plants on the way to the alpine meadows. The animal would graze for 10 to 15 days before moving on, and their shepherds would take care to see that they didn't stay in one place for too long.

The people themselves treated the flowers and plants with the utmost respect: they went barefoot, flowers were never picked before September and very sparingly even then; in fact, the flowers could not be picked without first worshipping the gods. Wearing brightly coloured clothes was also forbidden. The conservation instinct was thus reinforced by religion.

All that changed in the mid–70s, when the forest department decreed that the villagers should lead their animals along the side of the valley. Years later the area was declared a national park. Ironically, Bhyundar women in 1978 had taught the forest department a lesson in conservation by successfully protesting against the felling of trees.

Now, bereft of the care of its traditional keepers, the beautiful region is in danger. Since the entry of animals has been restricted, weeds have spread. Tourists pick flowers indiscriminately. Forest officials connive at the illegal picking of medicinal plants. Trees are merrily felled for firewood: the monthly consumption is 80 tonnes—mostly for the visitors as the valley's residents consume little. Vegetation has been swept away to make helipads for VIPS, most of whom have never come. And last but not least, the valley is now facing its biggest threat from the construction of a hydel project at Vishnuprayag.

As for the villagers whose religious care kept the flowers blooming for decades, they are seriously affected by the fiat forbidding the valley to them. The entire economy of the region depends on sheep and goat-rearing and the wool trade. Some now keep horses and earn money by taking travellers up the road to Hemkunt and the Valley of Flowers. A few have set up tea-stalls to cater to tired trekkers. The number of sheep, too, has declined: Chamoli district had 125,000 sheep in 1961 and today this number is down to 75,000.

The effect of the traditional form of grazing can still be seen in the upper watershed areas of Dudhganga, which are in excellent condition. But the forest department is making one mistake after another. In 1965, it allowed Gujjars to graze their buffaloes and horses in the meadows of Rudranath and Tungnath and their hooves have damaged large areas where plants can no longer grow. Not only are the authorities blind to the wisdom of tradition, they persist in compounding blunders.

### Multiplying too fast

The maximum number of deaths is in an entirely different part of the country—in the swamps of the Sunderbans park in West Bengal, which covers 2585 sq km, and accommodates 205 tigers, the largest by far of any Project Tiger area. According to a paper presented by two Indian experts at an international symposium on tigers in New Delhi in 1979, 648 humans were killed between 1960 and 1977 there. The problem is somewhat different in this estuarine tract where fisherfolk and honey collectors have often fallen prey to tigers for many years.

Previously, there were cases of tigers turning human eaters because of an incapacity which made it difficult for them to hunt. It is only now that tigers are multiplying faster than the national parks can cope with, specially those in Project Tiger. The media has usually reported cases of individual humaneaters and has only highlighted this new phenomenon recently. The real bulge in the big cat population has taken place only in the last few years.

While the needs of people and those of the tiger prove by far the most controversial case of conflict, similar problems have arisen elsewhere. In the famous Keoladeo

## Avian Drama

There is not a single square kilometre in India without a bird. Of 8,600 species in the world, this land harbours 1,200. With only four per cent of the earth's land surface India has representatives of 20 of the 27 bird population orders in the world. Counting the geographical races or sub-species, India can boast of 2,061 bird forms, 1,750 resident here and the rest migrants from northern regions; 180 species are endemic—they are found nowhere else. The rest display close relationships with Palaearctic, Ethiopian and Indo-Chinese varieties.

In an agricultural country, birds are crucial for the ecological balance. For instance, the Black Drongo *(Dicrurus adsimilus)* preys on winged insects, protecting the crops. Some, like the Roseringed Parakeet, seem entirely harmful as they eat no insects, just grain and fruit. Others such as the wagtail are principally insect eaters, and keep down the insect population—some 50,000 species ranging from locusts to termites. Many bird species feed their young enormous amounts of insects as food. Hawks and owls take care of bigger vermin: rats and mice. Interfering with bird power can be dangerous: Holland and China discovered this when they massacred sparrows thinking that the harvest would double; in fact, it was decimated because insects flourished unchecked.

Birds have other functions. They spread tree seeds and are important cross-pollinators of plants. Because their hearts beat 100 times a minute as against the human rate of 72, they absorb poisons quicker and are convenient indicators of pollution—canaries were used in coal mines to warn miners of deadly carbon monoxide.

Tragically, Indian birdlife today is in a state of siege because of deforestation, extensive agriculture and predatory humans. For example, overhunting has extensively damaged our Galliformes, particularly of the Phasanidae Family—quail, partridge, pheasant and junglefowl. Their preferred habitats of scrub forests and grasslands are nearly gone.

Synthetic chemicals, including those used to boost crops, are a powerful menace. Reported victims of this are the bushchats in south India and the Peregrine Falcon—its eggs, and those of several other birds of prey like the king vulture, and the giant golden eagle, break easily now because DDT has somehow made the shells thinner. In Nelapattu in Nellore district of Andhra Pradesh, a local chemical factory is reportedly affecting bird life. Migratory birds are staying away from the Pulicat Lake, a grey pelican stopover, after it was divided into sections separating the deeps and the shallows, which inhibits the propagation of fish and prawn resources. The oxygen content of water in and around the Bharatpur sanctuary was found to be as low as 0.7 milligramme per litre as against the tolerance level of 5 milligramme a litre; it also smelt of hydrogen sulphide and was highly alkaline.

Cranes and bustards hit the headlines recently when they were the subject of international conferences. Less than 500 Black-Necked Cranes *(Grus Nigricollis)* remain, on the Tibetan plateau, in Ladakh and in Bhutan. Plans are on to guard its breeding areas, and artificial breeding might also be tried by placing some eggs in incubators. The Siberian White Crane *(Grus leucogeranus)* is also in danger: but 38 came to the Bharatpur sanctuary in 1983 as against 36 in 1982. Apparently, a reasonably sized flock has been located in China.

Four of the 23 Bustard species are found in India. The Great Indian Bustard has been a favourite of sportsmen since Mughal days, and it lays only one egg, which explains why only 745 were counted in 1978 by Dharmakumarsinghji of Bhavnagar, an authority on the bird. But there is hope. Dr Lindon Cornwallis of the International Council for Bird Preservation wrote of its "reappearance .... in areas where forest pasture management projects have been established." Small remnant groups have been located in Maharashtra, Madhya Pradesh and Karnataka.

Of the three other Bustard species, the migrant Houbara *(Chlamydotes undulata)* has been preserved from Arab sheikhs and their falcons following a public outcry, and the Bengal Florican *(Houbaropsis bengalensis)* and the Lesser Florican *(Sypheotides indica)* are likely to be saved from oblivion. In fact, a sizeable flock of the Lesser Florican was recently discovered in Ratlam district of Madhya Pradesh after 35 years.

Endangered species notwithstanding, India still has a tremendous wealth of bird life. The Crimson Breasted Barbet can be seen in the busiest cities, Tailor Birds and Wren Warblers nest in verandahs, mynahs, crows and sparrows are everywhere. The Black Drongo, the Golden Oriole, the Iora, the jungle and whiteheaded babblers, White Eyes and sunbirds, attractive birds all, seem to be getting used to human pressure. For example, Prakash Gole and his associates counted 22,000 birds in the main wards of Pune city and cantonment: 2.6 birds a hectare. In Pune's Mula-Mutha Bird Sanctuary, 110 species have been recorded.

Coastal areas encourage rich bird life. Madras, for instance, plays host to winter visitors and thousands of passage migrants in late autumn and spring. The Least Frigate Bird *(Frigeta ariel)* was twice noticed in flight. Both flamingo species are seen, as are the Grey Pelican at Pulicat, the Whitebellied Sea Eagle at Adyar estuary, and the Osprey at Pulicat (and at Manali). The waders are there in strength, from the Curlew, the largest, to the Little Stint, the smallest. Other sightings include the Rednecked Phalarope near Vellachari and the rare Oyster Catcher, noticed twice at Adyar estuary.

As many as 233 species have been recorded at the famous Point Calimere sanctuary, south of Madras in Tanjore district, a major wintering ground for migrants from the north. A recent survey by the Bombay Natural History Society recorded several new species. Conservationists are worried that the oil exploration shortly to begin here will damage the unique natural habitat and the Government has set up a committee of naturalists to recommend ways to minimise damage.

Kerala, despite its long coastline, has been a bit of a disappointment. The backwaters attract large numbers of gulls and terns, but there are few beaches where waders feed and roost undisturbed. Birds of prey, as everywhere else, are declining, among them the Whitebacked Vulture, the Brahminy Kite—now found only on the coast—and the Marsh harrier. On the other hand, the Blackwinged Kite is now seen in areas where it was not found before, aided perhaps by the opening up of forest areas.

The only birds to thrive in the state seem to be the two crows, the pariah kite and the house sparrow. The establishment of plantations and the loss of natural forest have affected numerous species, including the babblers and bulbuls, and some owls and woodpeckers. Wintering wild fowl used to visit the state in large numbers some 50 years ago; now small groups visit only two or three places in Kottayam and Ernakulam district.

There is a lesson for everybody in the Chotanagpur plateau of Bihar, which consisted of big areas of dry sal and excellent deciduous forests noted for their avian richness. The birds included the Imperial Green Pigeon and the Rufus-bellied Hawk Eagle. Now the habitat has been drastically transformed, and the birds are gone. If India learns its lesson here, and from dozens of other habitats, ravaged by humans, it could save other species from oblivion.

## Strange Creatures of India

### Gangetic dolphin

Born completely blind, the Gangetic dolphin *(Platanista gangetica)*, remains sightless for the rest of its life. Nevertheless it does get by perfectly well, having adapted to a sightless existence in its murky, river habitat. Not to be confused with marine dolphins *(Delphinidae)*, the fresh water dolphins *(Platanistidae)* have lost all contact with the sea. They search for fish crustaceans and other such organisms by sweeping the river bed with their sensitive muzzles. Freshwater dolphins must come up for air every one or two minutes. During the day the dolphins prefer to stay in deep water, coming out at nightfall to feed in the shallows. Hydroelectric projects and the large fish nets of fisherfolk pose considerable problems for freshwater dolphins but in recent years positive steps have been taken to identify and protect some of their known habitats in the Brahmaputra, Indus and Ganges rivers.

### Civets

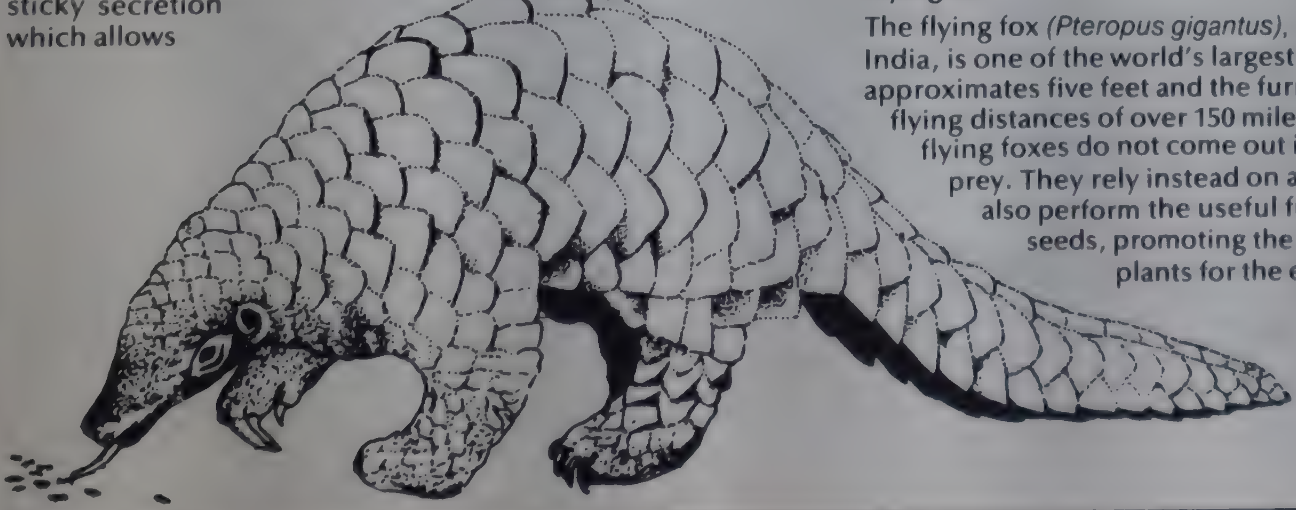
Civets are cat-like creatures with elongated bodies that resemble those of weasels. Solitary and nocturnal, these carnivorous creatures spend the day in hiding, coming out to hunt small birds, mammals or reptiles at night. To accommodate their 32 to 40 teeth civets have evolved a longer snout which further differentiates them from the cat family. In India, Sri Lanka and even further east lives a civet that has come to be known as the 'toddy cat'. This creature, the Palm civet *(Paradoxurus hermaphroditus)* has a tail as long as its body and derives its name from its odd preference for fermented toddy. It often lives close to human habitation and, as many have discovered to their unpleasant cost, can give off an extremely foul, clinging odour from its anal glands if disturbed. The palm civet is less carnivorous than its cousins and has specially adapted claws suitable for climbing the straight palm trunks.

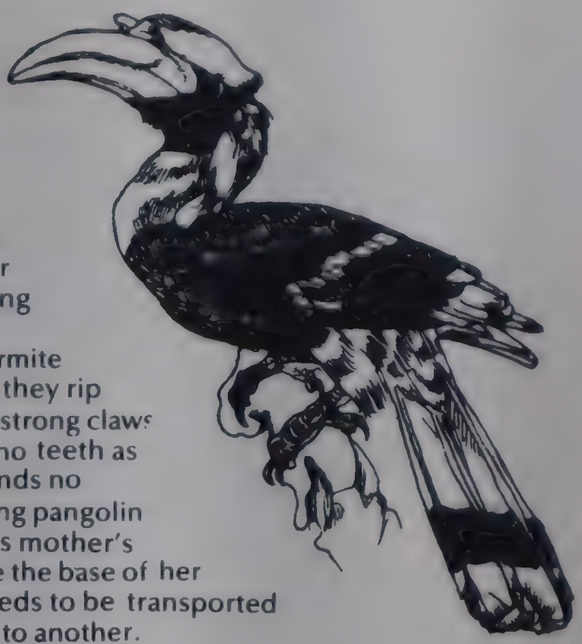
### Ant lion

Very often one comes across small sand-ringed holes in the soil. These structures are the trap-cum-homes of insects known as ant lions. An ant lion larva digs a steep tunnel in loose earth and lies in waiting in the pit thus created with only its deadly pincers and head showing above the surface. A small insect which wanders too close, slides down the rim and cannot recover its balance as its legs get no purchase from the crumbly slopes. The ant lion larva shoots up a spray of sand, which hastens the hapless victim towards its end. Having fed heartily on the digestible insides of its prey the tiny predator spits out the husk and patiently waits for the next victim.

### Indian pangolin

The Indian Pangolin *(Manis crassicaudata)* has evolved a scaly body covering, fabricated out of modified hair. As protection against predators, it rolls itself into a ball and raises its sharp scales. These anteaters are mainly terrestrial, have no external ear openings and can seal their nostrils to protect themselves from ant bites. Their long, extensile tongues are coated with a sticky secretion which allows them to capture ants, termites or larvae by probing deep into the labyrinths of termite mounds which they rip apart with their strong claws Pangolins have no teeth as their diet demands no chewing. A young pangolin will perch on its mother's back, just above the base of her tail, when it needs to be transported from one place to another.





### Great Indian hornbill

The great Indian hornbill (*Buceros bicornis*) is a large, ungainly bird with strange nesting habits. The female seals herself into a hollow in a tree whereupon her feathers soon moult. The male dutifully brings her food for the entire period during which her eggs are incubated; feeding her through a narrow slit in the 'prison' nest.

When her young grow and their appetite increases, the female breaks down her prison doors to help the male obtain food. The young now rebuild the damaged portion of their home to seal themselves in. The hornbill's nesting behaviour serves to protect defenceless young efficiently.

### Indian giant squirrel

This large nocturnal rodent, the Indian giant squirrel, *(Ratufa indica)* lives in the upper canopy of trees and seldom ventures down to the forest floor. Flaps between its body and its extremities act like parachutes and enable the large mammal to sail or glide from tree to tree covering as much as 20 feet in one 'leap'. The flying squirrel evolved the art of gliding as an evolutionary adaptation for predator escape and also as a means to reach food sources (other trees) by expending the least amount of energy.

### Mouse deer

This is a deer which stands just 12 inches off the forest floor. It has no antlers but the male has downward pointing canines that look like tusks. Its small size helps it to evade predators by hiding beneath even very low bushes and low vegetation. The chevrotain (*Tragulus meminna*), also called the mouse deer, has actually been observed bolting up the hollow of a tree when pursued by dogs. Timid and gentle, these dwarfs of the Indian jungle lend enchantment to the forest and are the subject of several fanciful tales in Indian lore.

### Flying fox

The flying fox *(Pteropus gigantus)*, found commonly all over India, is one of the world's largest bats. Its wingspan approximates five feet and the furry mammal has been recorded flying distances of over 150 miles. Contrary to popular belief, flying foxes do not come out in search of human or animal prey. They rely instead on a diet of overripe fruit. They also perform the useful function of scattering fruit seeds, promoting the growth of fruit-bearing plants for the entire jungle community.

## A Weed for All Seasons

A weed can be defined in two ways. It is a plant capable of spreading rapidly and it is a useless or noxious plant. Plants which multiply rapidly and disperse far and wide have been around since before humans came on the scene. Such plants flourish in unstable habitats, created, for example, by landslides or floods. They quickly colonise a newly opened up patch of land, multiply while the going is good, and get away to a new disturbed patch when the first one develops a more mature plant community. Such habitats were rather rare before humans came on earth, and the weedy plants were a minor component of the earth's biota. Humans, however, from the early days began to create, on a large scale, habitats favourable to weedy species. The earliest tool they employed for this purpose was fire. By regular burning, a practice, which they began some 350,000 years ago, they vastly increased the area of disturbed habitats ripe for colonisation by the weeds. They thus created huge grasslands where there were forests. In fact many of the grasslands in the world today, including most of those in India, are the handiwork of human beings.

Grasses were the first weedy plants favoured by human interference, when humans became farmers and herdspeople, it was these grasses that formed their cereal crops and the basic food for their livestock. But croplands created by human beings are homogenous, unstable habitats and plants other than crops also began to take advantage of these habitats and compete with the crops.

Although farmland weeds are a nuisance, they can be dealt with when the land is cared for intensively. Under primitive agriculture, huge tracts of land remained as forest or grazing lands. The plant communities were somewhat modified by human use, but not so seriously disturbed as to constitute habitats for weeds. The pace of exploitation of such uncultivated habitats, however, quickened as we approached modern times. Human beings now encounter weeds not only in croplands, but also in forests and grazing lands.

One such "weed" deserves special mention. This weed is bamboo, which grows well whenever the forest canopy is opened up. When the British initiated large-scale plantations for teak by clearfelling natural forests a century ago, bamboos came up in profusion and often suppressed teak. The forest working plans therefore began to prescribe the eradication of bamboo as a weed. On the contrary, bamboo has been a plant of tremendous value to India's rural population for centuries For the forest department, bamboo ceased to be a weed and became a resource only when it became an industrial raw material for paper manufacture.

The growth of British-inspired forestry saw further disturbance of forest habitats and thereby the introduction of more weedy plants. The first of these was *Lantana*, a mildly thorny shrub that spread all through Indian forests. It depends on birds to eat its berries and spread its seeds in the drier tracts. Its counterpart on grazing lands is the prickly pear (*Opuntia*) which also produces a juicy fruit consumed by animals and human beings. The prickly pear was controlled by a biological control agent, an insect called *Cactoblastis*. Attempts at controlling *Lantana* , however, have not yielded positive results.

In the post-British era, the exploitation of forest and grazing lands accelerated. There are also newer, and even more noxious, weeds like *Parthenium* and *Eupatorium*. Both of these are composites with light, wind-dispersed seeds. Both are left untouched by livestock and even the all-consuming goats. *Parthenium*, beginning with seeds brought in with PL 480 wheat, has fanned out from Pune where it first established itself in 1961, to now cover the vast drier tracts of the Indian peninsula. *Eupatorium* has come to us from Burma, supposedly with the British army retreating before the Japanese. Today it covers vast areas of the Himalayas, the Northeast and Western Ghats (in Kerala, Tamilnadu and Karnataka).

A third weed that has done well in recent decades is *Ipomoea*. It thrives in lands waterlogged by excessive irrigation and is now a common sight in Gujarat, Maharashtra and Madhya Pradesh. The standing water bodies themselves are being rapidly covered by yet another exotic weed, the water hyacinth (*Eichornea*). Kerala's waterways are today infested by another free-floating plant, *Salvinia*, a native of tropical South America which probably came in as a botanical curiosity.

As a matter of fact, India soon promises to be covered by just these four species—*Parthenium* in dry tracts, *Eupatorium* in moister tracts, *Ipomoea* on swampy grounds and *Eichornea* in ponds and lakes. Weeds are a symptom of the grand homogenising influence of human beings, who have eliminated the natural diverse plant communities by a uniform process of spreading fire, removing excessive quantities of woody material, building up enormous grazing pressures by domesticated animals and adding organic matter to water bodies. •

and shelter from the ravages of man. The objectives were straightforward and so were the instructions to personnel chosen to implement Project Tiger. 'Do nothing (to the habitat) and allow nothing to be done by others.' It was felt that nature was its best physician and that self-evolved, natural systems would soon take over to improve tiger-land. The rest is now history."

Unfortunately, the rest is not quite the kind of history that the Project Tiger enthusiasts envisaged. Critics have pointed out that for thousands of bewildered villagers around sanctuaries, the tiger's future has suddenly appeared more important than their own. Since nearly all of them are tribals, they have been badly hit by being denied the right—which they enjoyed for centuries—to gather food, fuel and fibre from forests which have now become the preserve of the big cat.

Villages are only relocated from the core areas of national parks. They remain in the buffer zones and in most sanctuaries though there are isolated attempts to move them out of the latter as well. The Wildlife Conservation Act, 1972, does not refer specifically to people living within sanctuaries but stipulates that when an area has been declared a sanctuary, the collector can "inquire into and determine the existence, nature and extent of the rights" of persons over the land they owned in the area. The collector also has the power to acquire such land and rights.

The problem can only grow more acute as the drive to save the tiger and other wildlife gathers momentum. Only a year ago, the Project Tiger steering committee decided to bring four more reserves under its charge, bringing the total to 15. (It also discussed the problem of humaneaters in Lakhimpur Kheri in Uttar Pradesh: presumably, the deaths so close to the capital attract more attention than in the remote corners of the country.)

### More area for tigers

Some conservationists admit that there is a problem and point to the solution—to enlarge the area of the parks. Thus there is already a notification to increase Bandhavgarh's area from 110 sq km to 370 sq km and Corbett's may be increased from 480 sq km to 1580 sq km. This means that villagers have to be shifted to make room for the tiger: in Kanha National park, just south of Bandhavgarh, 22 villages with a population of 40,000 were moved. "Relocation of villagers is a very good answer for two reasons," says Sankhala. "Everyday confrontations with wild animals like boars, which can destroy village fields overnight can be avoided: impoverished people can be helped to modernise their agriculture at the new site, as was the case in Ranthambor." Sankhala recently retired as Ranthambor park's director.

Some critics would see this solution as the problem: why should people make way for the tiger? While it is true that in many cases where relocation has taken place, villagers are better off (Kanha is a good example), they retain a strong bond with the forests and should at least be employed in forestry practices in and around the sanctuaries. Many former villagers in Kanha, for instance, are engaged in fire-fighting operations.

Meanwhile, unless the authorities do some hard thinking on laying down a line between what belongs to the tiger and what belongs to people the problem will only worsen. Ideally, humans and beasts should live in harmony. With the introduction of special protection measures, however, wildlife is bound to encroach on human territory. Already the situation is getting out of hand. A villager of Lakhimpur Kheri asks bitterly: "Are human beings more important or these monsters of the forest? Kill all the tigers!" And addressing the Advertising Club in Bombay early in 1983, Sankhala retorted bitterly: "What does it matter if one or two humans are killed?"

Other conservationists argue that things have got out of control and believe that excess tigers should be captured, sent to stock other sanctuaries and given away to zoos at home or abroad.

## The Fate of a Weed Killer

April 1, 1976 was a day that took many agricultural scientists of India by surprise. On that day, Chandra Sekhar Lohumi, a primary school teacher with only eight years of schooling, was presented a special cash award by the Indian Council of Agricultural Research (ICAR) for his contributions to science.

In 1966, at the age of 62, Lohumi was transferred to a primary school in Naukuchiyatal, Nainital district. There he found that the spread of a semi-thorny weed called Kuri (*Lantana*) had become a nuisance for the villagers. *Lantana* is unpalatable to animals and its fruit makes them sick.

Lohumi decided to find a way to destroy *Lantana*. First brought to India by an Englishman from Central America, Lantana is now found in the hill areas of UP, in the Yamuna and Gandak basins, and in large areas of Bundelkhand, Vindhyachal and the Himalayan pine zone. Every year thousands of acres are colonised by it and even though cut extensively for fuel, it does not die.

Lohumi was reminded of a lecture in 1923 in which the speaker had talked of an insect used to destroy a cactus in Australia. One day when someone told him that a few *Lantana* bushes at a spot 6 km from the school were withering away, he concluded that some insect must be killing these bushes. He went off to inspect the bushes but even after looking around for seven days, he could not find any insect. One day, by chance, his stick hit a *Lantana* bush, and many insects began to fall. He collected the insects and brought them home to study their behaviour.

When he spread the insects on bushes near his school, the plants began to die. The next year *Lantana* bushes began to reappear. Although this disheartened Lohumi, he persisted in spreading his bug. The next year, *Lantana* bushes failed to appear. Lohumi concluded that the insect takes three years to eradicate *Lantana*. Then he began tests to see if the insects would eat any vegetation other than *Lantana*. He found that they would not touch anything else. Scientists from the G.B. Pant Agricultural University at Pantnagar, however, argued that forestry experts had imported insects from Australia in 1941, which killed not only *Lantana* but also a valuable plant like teak. These imported insects had, therefore, been destroyed. They felt that Lohumi's insects could be from the same stock as some insects may have escaped in 1941.

To remove this misunderstanding, Lohumi invited entomologist P.S.Parmar and a forest conservator to a spot where both teak and *Lantana* were growing, but where the insects had eaten only the latter. The ICAR also sent an expert group to assess Lohumi's work, which recommended that Lohumi be awarded by ICAR.

When Lohumi was asked a few weeks before his death in early 1984 why the government had not made use of this insect to eradicate *Lantana*, he explained that the strongest opposition had come from foresters who argue that the weed is helping to cover the bare deforested soils.

Eradication of *Lantana* will only increase soil erosion. With soil conservation programmes totally inadequate, it appears that weeds at least are doing something to hold the soil. Lohumi died an unhappy man.

# AGENTS OF CHANGE

*The government, which owns, controls and develops India's forests, dams, power stations, roads, mines, and a large part of its industry, is not just the protector but also the most feared destroyer of the country's environment.*

*The Department of Environment — the government's main instrument for creating an eco-consciousness both within the government and outside — was intended to be quick-responsive, independent and innnovative, but environmentalists believe that it lacks these attributes and real power.*

*Environmentalists also believe that the government is not sensitive to the impact of environmental degradation on the lives of women, tribals, nomads, fisherfolk and others who depend on the environment for survival.*

*Indian industry is extremely reluctant to control pollution. A leading industrialist recently raised the bogey of inflationary tendencies because of investments in pollution control.*

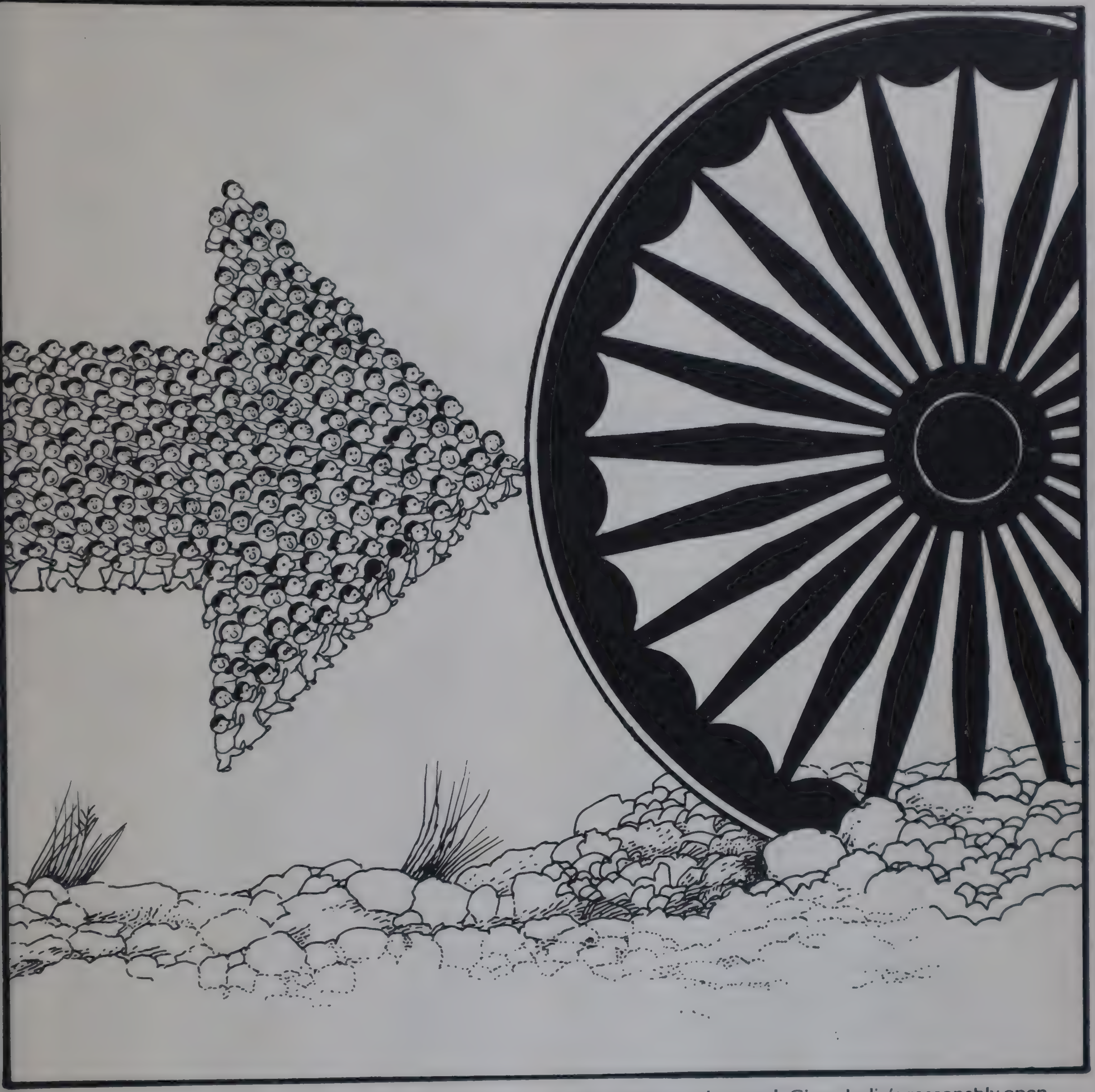
*Grassroots voluntary organisations argue that the degradation of the natural environment — the degrading human-nature relationship — simply mirrors the degrading human-human relationship in society.*

*Voluntary groups have made excellent social and political analyses of environmental problems but they lack trained personnel to undertake indepth techno-economic analyses and access to authentic official data. Issue-oriented networks are being formed to overcome these handicaps.*

*Laws enacted to control environmental degradation exclude the people from their implementation. No citizen can take a polluting company to court under the Water Pollution Control Act. Only an appeal can be made to the Water Pollution Control Board.*

*The Water Pollution Control Act was passed in 1974 but the first prosecution came in 1983. The factory's manager received a jail sentence; the proprietors went untouched.*

*India is a reasonably open society. But right to know laws are crucial. Experts twice overruled Thal-Vaishet, near Bombay, as the site for a fertiliser plant. But the then chief minister told the legislature that the choice had been approved.*



It looks as if the winds of change have finally begun to blow. The government at least on paper, has begun to recognise its responsibilities towards environmental conservation and rational management of natural resources. But, as in the rest of the world, in India too, environment ministries have failed to bring about an eco-consciousness across the breadth of the government. These ministries continue to be, at best, the struggling environmental conscience of the government but with little clout.

The burden for educating the public and creating a broad public demand for governmentwide responsiveness towards environment, thus, falls on the voluntary sector, which in India has not only played the role of the environmental opposition, but has also played a pioneering role in developing alternative models of equitable and sustainable use of natural resources built around people's participation and control. Given India's reasonably open society and easier access to press and courts, the government is not in a position to ignore the voluntary sector. But while this helps to bring in some respect from the government, at least in dealing with the more-publicised voluntary organisations, it also brings in conflicts.

The following chapter consists of three sections. The first section presents the responses of leading environmentalists and voluntary organisations to a questionnaire seeking their views on the government's current and future role in environmental management. The second section describes the growing interest of voluntary organisations in environment and their problems and perspectives. The third section deals with the laws that have been enacted in recent years to deal with environmental degradation.

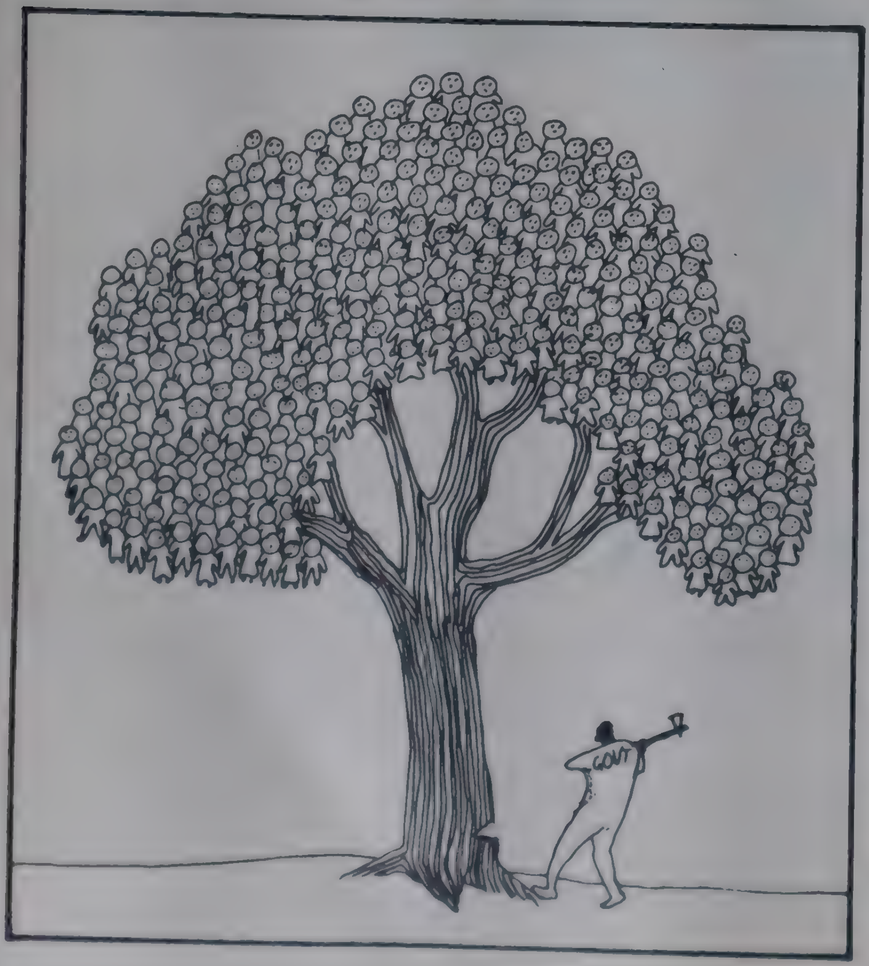
# GOVERNMENT

The Central and state governments of India are mammoth entities. They own, control, and develop almost all the country's forests, dams, major irrigation systems, power stations, railways, ports, roads, mines and an overwhelmingly large portion of its industrial structure. Inevitably, the government is not just the protector of the country's environment but also its most feared destroyer. The responsibility of the government agency which is charged with nothing less than the creation of a national and governmental 'environment conscience' is therefore immense.

The keeper of this all-important conscience is the fledgling Department of Environment (DOEn) — four years old — which succeeded the National Committee on Environmental Planning and Coordination (NCEPC) set up in the early 1970s and wound up in the early 1980s. The DOEn has a staff of 237 and spent nearly Rs 20 crore in 1983-84 on diverse activities such as environmental impact assessment and maintaining the National Museum of Natural History.

The DOEn's major areas of work include the prevention and control of air and water pollution, botanical and zoological surveys, monitoring the environment, researching it, spreading the environmental good word and examining the impact on the environment of development projects. As the field is still information-poor in India, the DOEn is establishing an Environmental Information System (ENVIS) with a computerised national network of information centres. It is also setting up a National Environmental Monitoring Organisation (NEMO) to keep tuned in on changes in air and water quality and natural ecosystems. Meanwhile, the department is promoting what it calls centres of excellence in universities and research institutions.

The states are not lagging behind: 18 out of 22 have either an environment department or an environment section in their department of science and technology — the last to set up one was Meghalaya. The union territories are under the DOEn's aegis. So rapid has been this institution-building phase that most state governments are short of experts who can evaluate development projects : Meghalaya has offered high salaries but still has difficulty getting properly qualified people.



How confident are the people, after all this intense activity, that the country's environment will be suitably protected and developed? If the response that the editors of this report have received to their questionnaire is any indication, the answer is not very.

The reason is not far to find. The hopes that DOEn raised were too high and it hasn't even, so runs opinion, begun to live up to them. The fast-growing breed of Indian environmentalists can be divided into two parts: the milder 'reformists' who restrain themselves to advocating corrective action in the belief that this alone will save the greenery from further mauling and the 'revolutionaries' who see environmental issues as inextricably linked with poverty, unemployment, oppression and inequality, and feel that the 'greenocide' is inherent in the process of economic growth imported from the West. They argue that any new process must be built on environmentally sound principles as well as those of social and economic equity.

### Public dispensary

Not surprisingly, the revolutionaries are grassroot activists, and many are involved in campaigns and attempts to mobilise the people against the slaughter. For them, the DOEn, is a vital part of government which should be at the centre of all development activities. Rajiv Vora of the Gandhi Peace Foundation (GPF) speaks almost for everybody when he says that the department should not be a mere "public dispensary" of funds but a "touchstone". Vora explains: "Environment is the touchstone for development programmes to be rated as constructive or destructive. A Department of Environment of the government should be invested with the authority to examine each and every development plan and programme on the merit of its environment worthiness. This would imply that its status as a government department would have to be much higher that even the Planning Commission's. In fact, the Planning Commission plus such a Department of Environment would alone make a real Planning Commission."

Ranjeev of the Bihar Ganga Mukti Andolan makes almost the same point. The minimum we should expect from government environment departments, he says, is a frank and public evaluation of past development plans and programmes and independent and frank evaluation of the environmental impact of future projects. The department should have the authority to force planners and project executors to bow to its dictates.

Some respondents even go beyond Vora and Ranjeev's desire to see the DOEn as an environment ombudsperson. Anupam Mishra of the GPF, in fact argues, that the department should not only be a more strict policeman directing the traffic of development projects but should plan the traffic itself by virtually developing a new concept of economic and social development based on a sustainable and equitable use of natural resources. This point is strongly stressed by, among others, S. Santhi and Sathis Chandran

Nair, activists from Kerala and by Ashish Kothari of Kalpvriksh, a group active among Delhi students.

For instance, it is not, just a question of protecting forests but also of telling the government the most sustainable and equitous way of using forest resources. Most of the younger environmentalists believe that the DOEn cannot take up the challenge and dismiss the department as another bureaucratic swamp interested only in maintaining the status quo. Others fear that, even worse, the DOEn could provide the government with a convenient facade of change, thus making the efforts of those genuinely working for change even more difficult.

**Government-wide impact**

Almost all respondents assessed DOEn's impact on other Central government agencies and state governments and the final diagnosis was gloomy. Industrial consultant L.C. Jain pointed out that no change is perceptible in the activities of the forest, industry, irrigation and public works departments. Almost all respondents asserted that the governments of their state had done precious little to protect the environment.

Most respondents believe that if horizontal diffusion of environmental concern within the government is limited, vertical diffusion is almost non-existent. Says T.N. Atrey, a Gandhian social worker who helped translate the last State of India's Environment report into Hindi, "I have no contact with the higher levels of government. But at the lower level, in the village where I live and work, I can't see anything which would make me believe that the government takes environmental issues into account in its decision-making."

Darryl D'Monte, leading journalist and former Homi Bhabha Fellow who has actively written about many environmental controversies, says: "Take the Bhopalpatnam-Inchampalli dams (against which the local people have organised a major protest campaign). The DOEn is the last authority to be consulted, although the environmental impact is of fundamental importance. The environmental factor has only been raised in official circles by ad hoc bodies like the Jungle Bachao, Manav Bachao Kriti Samiti and by social workers like Baba Amte. Surely, the DOEn should have figured in the discussion from the very outset." Giving a classic example of how environmental impact assessment within the government takes place in reverse gear, Colonel B.L. Verma of Action for Food Production (AFPRO) points out: "All the superthermal power plant locations have been decided. Environmental impact assessment is now being considered."

Though Sunil Roy, former Indian high commissioner to Nigeria, and now a full-time freelance environmental agitator, believes that the "DOEn is beginning to have influence on development ministries, which is both significant and resented," he, too, is quite forthright in his concluding observation: "I don't think the government as a whole has become environment conscious. Certainly such consciousness as exists is concentrated at the highest level, the Prime Minister and the specialised departments — Environment, Ocean Development and some segments of the Planning Commission." Several respondents pointed out that the interest in environment at the top may essentially be a superficial derivation of former Prime Minister Indira Gandhi's known interest in environmental issues.

**Dependent people**

None of the respondents, including those who have worked in government, believe that the government takes into account the needs of women, tribal, nomads, fisherfolk and others who depend on the environment for their very survival. They report many experiences in which the government has undertaken projects which has not only destroyed the environment but has also been 'anti-people'. Says Rajesh Tandon of the Society for Participatory Research in Asia, which has been involved in research on forest needs of people since the workshop to protest against the Forest Bill was held in New Delhi in 1982: "Consideration of export and other income generating ventures influence the planning of various projects. In Chamba district of Himachal Pradesh, the government programme of afforestation is promoting massive cultivation of olive trees, which the local population has never seen or heard of before. This is being done primarily for export promotion and production of olive oil. The needs of the local population are totally unrelated to olives. This scheme is further eroding pasture lands and other common village lands which are being brought under olive cultivation."

Dunu Roy of the Shahdol Group has an even stronger comment to make: "In all the mining areas of Madhya Pradesh as well as areas where land has come under submergence, the people affected are regarded by government servants as being impediments in the path of development to be removed at minimum cost. The government takes the same attitude even for private sector projects. When Orient Paper Mills was set up, it was the district collector who used the government machinery to threaten and evict those who were reluctant to leave the requisitioned land."

A respondent from Gujarat has a telling story to narrate: 'My field experience is only in tribal areas, and that too mostly in Dangs. At that level, the tribal forest village, I do not see any environment consciousness from the government bureaucracy. Monoculture of trees is fast becoming the norm in Dangs. This destroys the great mixture of ground vegetation, decimating the small wildlife population, leaving the larger wildlife to prey more commonly on villages. The whole balance is destroyed, forcing the tribals to become enemies of wildlife.

"Medium scale dams are planned in Dangs which would displace many, and there is no provision to give oustees other land, as the whole area is protected forest. Government planning is often ludicrous. In Dangs, the Vanil Udyog set up by the forest department trains 300 tribals in carpentry every year. There are 311 villages in Dangs, and each one probably needs only one carpenter for local needs. What will all these carpenters do? Presumably, if the government cannot employ them, they will go back to villages and cut timber to eke out a living from their new profession. Where is the logic? These same people will later get blamed by the forest department for destroying the forests!

"The forest department in all its programmes professes to care about the forest. But what I see is that tribals are harassed, beaten and forced to pay money for 'illegal' cutting, while forest department officials work hand in glove with traders to cut and market truckloads of timber illegally.

"Money seems to be the overriding consideration. At the forest level, foresters make money by extortion from the tribals and by collusion with non-tribals. At the government level, money is made by commercial exploitation and planting of the most valuable timber with scant regard for environmental balance."

Both Roy and Tandon argue that government officials listen only when there is organised protest. Says Tandon: "We have come across a district forest officer responding to pressures of organised tribals in Orissa. This points to the fact that the government responds only to organised pressures from below." Even then, Roy argues, the 'sensitivity' of officials is directed towards how to absorb, coopt, dilute or repress the protesting organisation.

Given these action-oriented expectations, DOEn's concentration on funding research projects and organising seminars has attracted adverse comment. As ecologist Madhav Gadgil of the Indian Institute of Science puts it: "A critical comment on waste of funds in holding trite conferences may be in order."

**Voluntary partners**

The need for government agencies to work with voluntary agencies has been stressed by several respondents, who argue that voluntary agencies will be the only true partners and supporters of DOEn in any real process of change, whether it is increasing the government's understanding of what is happening at the grassroots or in pushing those who matter in politics and power to adopt saner attitudes towards environment. Already, DOEn's high profile as a government department, which gets it high press publicity for all its statements, is mainly because of the concern that voluntary agencies have helped to create for environmental issues. B.L. Verma of AFPRO makes this point strongly: "I can only say that a government, central or state, will be environmentally conscious to the same degree as its people. It is people's audit or concern that alone will ensure the country's environmental survival."

**Respondents**

T.N. Atrey, a Gandhian social worker, translated the State of India's Environment — 1982 into Hindi;

M.L. Dewan, soil scientist, formerly with FAO, now involved with ecodevelopment in the Himalayas;

Darryl D'Monte, journalist and former Homi Bhabha fellow;

Zafar Futehally, conservationist, and member of the National Environmental Advisory Committee;

Dr Madhav Gadgil, leading ecologist with the Centre for Ecological Studies, Bangalore;

A.K. Ganguly, former member of National Committee on Environmental Planning (NCEP) and leading expert on site selection;

Krishna Murti Gupta, of the Himalaya Seva Sangh;

Pandurang Hegde, an activist of the Appiko movement in Uttar Kanara, Karnataka;

Mohan Hiralal Hirabhai, an activist of the 'Jungle Bachao, Manav Bachao Andolan', a movement against the Bhopalpatnam-Inchampalli dams;

S.K. Hiremath, with the India Development Service, Dharwad, involved in an agitation against the pollution of the Tungabhadra river;

John C. Jacob, of the Society for Environmental Education in Kerala (SEEK);

L.C. Jain, industrial consultant with wide experience of rural development;

O.P. Joshi, lecturer in a science college in Indore and active in environmental work;

Ashish Kothari, from Kalpvriksh, a student's environmental action group of Delhi;

Sharad Kulkarni, of the Centre for Tribal Conscientisation, involved in the campaign against the Forest Bill;

John Kurien, economist involved with the fisherfolk agitation in Kerala, working at the Centre for Development Studies, Trivandrum;

D'Monte also points out: "The non-government organisations give the environmental movement its dynamism and vigour." Many activists in organisations like the Kerala Sastra Sahitya Parishad or Society for Clean Environment even risk their government jobs when working on controversial environmental issues. Kartikeya Sarabhai of VIKSAT in Ahmedabad and now director of a new centre on environmental education stresses the same point: that the government must build links with NGOs and enlist their support in creating the awareness that is needed for ensuring that in attempting development we do not destroy our environment. The government could even get extremely valuable knowledge for its decision-making if it cared to consult voluntary agencies.

S.M. Mohnot of the University of Jodhpur stresses the need for DOEn to take up programmes involving voluntary organisations, schools, colleges and universities to create a broad based atmosphere of environmental concern. Says Mohnot: "DOE's programmes should give priority to those activities which can reach the masses in a simple language." Krishnamurti Gupta of the Himalaya Seva Sangh makes the important point that there is little effort by government to disseminate knowledge to poor and marginal groups about the dangers posed by environmental imbalance and give them correct guidance about the action that they should take. Pandurang Hegde of the Appiko movement in Karnataka, reports from his experience that the government instead of assisting people's environmental movements works against them through its experts.

S.M. Mohnot, primates expert from the University of Jodhpur, involved with ecodevelopment camps;

S. Santhi and S. Sathis Chandran Nair, leading environmentalists from Kerala;

Pankaj, with the Gandhi Peace Foundation, New Delhi;

M.K. Prasad, a member of Kerala Sastra Sahitya Parishad (KSSP), which spearheaded the Silent Valley campaign;

Ranjeev, an activist of the Ganga Mukti Andolan in Bhagalpur Bihar;

Bunker Roy, now advisor to Planning Commission on voluntary agencies, for long associated with the Tilonia project in Rajasthan;

Dunu Roy, from the Shahdol Group, involved with an intensive study of Shahdol district's environment and development;

Sunil Roy, former high commissioner to Nigeria, now a freelance environment activist and chairperson of the committee to review the Tehri dam;

Kishore Saint, formerly with Seva Mandir, Udaipur, working against deforestation in the Aravallis;

Kartikeya Sarabhai, of the Centre for Environmental Education, Ahmedabad;

Rajesh Tandon, of the Society for Participatory Research in Asia (PRIA), working with trade unions on occupational health hazards;

Barry Underwood, has worked with the tribals in the Dangs area of Gujarat;

S. Varde, member of the Legislative Council of Maharashtra, fought against destruction of Lands's End, Bombay;

B.L. Verma, an engineer with Action for Food Production (AFPRO) looking for alternatives to big dams;

B.B. Vohra, former chairperson NCEP, now chairperson, Advisory Board on Energy; and,

Rajiv Vora, with the Gandhi Peace Foundation, New Delhi.

D'Monte, too, finds that government support for NGOs is limited to urban-based NGOs and in the case of militant, rural NGOs which deal with life and death issues of people, its role is often adversary. Says D'Monte: "The government has been apprehensive about the activities of the more militant adivasi movements to safeguard their rights, often treating them as law and order issues rather than one involving the loss of livelihood. On many urban issues, on the other hand, like the work of the Indian Heritage Society, it is much more cooperative (as a matter of fact, the Union Irrigation Minister, Ram Nivas Mirdha, continues to head this NGO). The massive official patronage extended to the newly set-up Indian National Trust for Art and Cultural Heritage, under the chairpersonship of Rajiv Gandhi, also demonstrates this. In various environmental issues confronting Bombay, members of NGOs like the Bombay Environmental Action Group and SOCLEEN have actually been appointed on an environmental advisory committee formed by the Petroleum Ministry. Members of the Save Bombay Committee are on the committees to beautify the city."

### Bureaucratic ways

Several NGO respondents have also pointed to the bureaucratic ways in which DOEn grants funds. Its response is neither fast nor flexible, attributes vital for any government agency dealing with voluntary agencies. There have been cases where DOEn has taken two to three years to decide whether it will fund a particular programme. Its response is particularly sluggish and unhelpful when the NGO programme deals with a controversial subject. But often it is plain bureaucratic whims that lead to delays and problems.

Says John Jacob of Society for Environmental Education in Kerala (SEEK), recounting his own experience: "We got grants from DOEn in 1982 and 1983 for our World Environment Day programmes. We cannot have the day on June 5 because it is in the middle of our monsoon. Also we cannot get students involved then as schools are not open. So we choose our dates in October and November. The DOEn accepted this and we got grants. Last year we had a month-long programme in the hill district of Wynad. But this year when we sent our proposals, the DOEn rejected them saying that they cannot help any environment day after June 5. If we had arranged a symposium with 'great men' (including ministers) they would have given us a grant. But not for our programme aimed at the common man."

The environmental issue is so large and diverse that for many environmentalists, existing institutions are simply not adequate. While noted conservationist Zafar Futehally in his reply laments the downgrading of the National Committee of Environmental Planning and Coordination into a National Environmental Advisory Committee with little teeth, Sunil Roy pleads for an altogether new organisation, a National Environment Commission. As one among equals, he believes that the DOEn cannot get the overriding authority needed even though the cabinet minister in charge is the Prime Minister. Roy wants a national commission that would be an autonomous regulatory authority with units in all states and union territories and environmental advisers in all central ministries, reporting directly to the National Development Council. As he puts it, what India needs is "an independent, innovative, quick-responsive organisation with overall responsibility and matching authority to coordinate and supervise all activities in the country having bearing on the environment."

In sum, it can be said that the Central and state departments of environment are among those agencies of the government that have attracted the maximum attention and interest of the public and voluntary agencies, and will increasingly do so in the future. Unless there is a partnership with the public, none of the objectives of these departments will be fulfilled, including those of convincing the other parts of the government about environmental considerations. The greater the partnership between the people and the government, the greater will be the chances of environmental survival and even of appropriate government response to ensure that survival.

## The Central Approach

**B.B. Vohra**

Many environmentalists are known to have expressed their disappointment over the fact that the Department of Environment, which was set up nearly four years ago with such high hopes, has not yet been able to make much of a dent on the problems it was meant to tackle. While this is no doubt true, any criticism of the Department on this score would be singularly unjustified.

It is inherently impossible for any single department to handle, by itself, the stupendous challenges presented by the country's environment. The major problems are of a nature which can be surmounted only by sustained efforts at the field level, and even then only if such efforts are fully backed by the concerned departments and ministries of both the Central and state governments.

What role should the Centre play and how? This is so because, although according to the Constitution, responsibility for all environmental programmes rests with the state governments, the Centre cannot evade its responsibility of playing the leadership and promotional role expected of it. If the country's growing environmental problems are to be contained with any hope of success, the Centre has no option but to persuade, inspire, enable and, if necessary, prod the state governments into taking suitable action on an adequate and timebound basis. How exactly should the Centre approach this task?

The traditional way is to address letters to state governments pointing out how vitally necessary it is for them to take action on various fronts. The only areas in which some, though by no means enough, progress has been registered are those of afforestation and the protection of wildlife. But this can be attributed more to the keen personal interest that the Prime Minister took for many years than to routine circulars.

The Centre's exhortations to states will carry conviction only when it establishes its own credibility and can demonstrate its ability to find practicable solutions only if it practises what it preaches within the areas for which it is directly responsible. Suitable environmental programmes must be formulated and implemented effectively in all union territories as well as in the numerous industrial and other public sector enterprises under the Centre's direct charge: railways, defence, public sector industries reporting to ministries like petroleum, steel, heavy industry and atomic energy. The Centre must also disseminate the environmental message through Akashwani and Doordarshan, besides the numerous government-run universities and schools.

Such an approach will not only give, on however small a scale, immediate practical shape to our environmental intentions and hopes but also confront the Centre directly with the kind of problems which the states will have to face and thereby enable it to deal with them with confidence and sympathy. To illustrate, the direct involvement of the Centre in the problems of deforestation in Arunachal Pradesh, of sanitation in Delhi and of pollution control in public sector steel plants will create an invaluable fund of experience as well as models for the states to emulate.

The awesome responsibility of saving the country from further environmental degradation must rest where it rightly belongs, on the Government of India as a whole. This will also destroy the convenient but self-deluding belief that the creation in 1980 of a small Department of Environment was all that was necessary to deal with the country's environment.

## Working with the People

**A.K. Ganguly**

A Department of Environment (DOEn) has been constituted formally. In the draft Environmental Policy Resolution accepted by the Tiwari Committee, it was emphasised that the government would constitute a quick-responsive, independent and innovative national organisation with adequate funds and humanpower. The Department of Environment is neither innovative nor quick to respond. It is also not equipped with the authority to discharge responsibilities as comprehensively delineated in the committee's report. The department is run by some very competent and committed technical officers and staff backed by a large administrative wing yielding decisive authority. The technical wing is extremely understaffed, even after four years of existence. DOEn operations are basically technical, and the administration should only serve the technical wing. But it is working the other way.

The DOEn should serve as a channel to carry the public and experts' views and reactions to the government. One of this nodal agency's basic programmes should be to establish links with voluntary organisations committed to environmental protection and improvement, and to promote the formation of such social organisations all over the country. The department should have a well thought-out programme of public education, incorporating the services of voluntary organisations, education of managerial cadre, politicians and decision makers. It should have a long-term policy of promoting education at all levels of learning in collaboration with educational authorities, in elementary schools, secondary schools, colleges and technical institutions.

The monitoring committee constituted for four projects in Maharashtra is an example of an experiment where some voluntary organisations have been inducted by the department. This committee has been functioning falteringly without any secretarial or administrative support. Whereas it has to deal with a large volume of documents and correspondence and respond to long and detailed commentaries, there is no support organisation yet, although the lacuna has been pointed out repeatedly.

The DOEn should serve as a catalyst in the promotion of the environment movement in the country. I do not know if the existing rules, regulations, and administrative procedures will ever allow it to rise to the occasion. Unless the organisation is quick to respond, independent and innovative in its activities, it will progressively become just another department that will keep itself busy pushing files and papers, preparing reports, disbursing funds and issuing approvals of projects.

## Government watches Resource Depletion

**John Kurien**

Unlike previous fisherfolk agitations in Kerala, the latest one spearheaded by the Kerala Swatantra Matsya Thozhilali Federation (KSMTF) has drawn great attention. The KSMTF has a list of 17 demands including a ban on trawling in inshore waters during June, July and August. This demand was first heard in 1981 leading to the setting up of the Babu Paul Commission, and continues to be their main demand, the toughest bone of contention between the fisherfolk and the boat owners' associations and the government.

KSMTF leaders, and particularly the fisherfolk among them, feel that indiscriminate and excessive trawling by a fleet of mechanised boats operating close to the coastline is one of the primary reasons for the drastic decline over the years in their catch. They see this as a consequence of seven to 10 years of unrestricted trawling confined to a constantly shrinking area of the inshore sea, the greatest harm done during the monsoon months of June-August when many of the commercially important fish species of Kerala are known to spawn.

The decision to ban trawling operations during the monsoon months is not an easy one because of the interests and the clout of both the fisherfolk and the boat owners. It is forced to resort to the convenient escape mechanisms of expert committees and commissions. The stand of the present government has been that monsoon ban will create a great deal of social disruption and loss of employment. There is also the argument that 'karikadi' — the only purely marine prawn which has now become the mainstay of the export trade during the monsoon months — may go waste if not caught, which will result in a huge loss of foreign exchange earning.

The history of Kerala's fish production can be divided into two phases: growth from 1964 to 1973 and stagnation from then on till 1983. In the former period the average catch was 3.59 lakh tonnes and the annual growth rate 1.8 per cent. In the latter period the average catch was 3.47 lakh tonnes with a growth rate of minus 1.5 per cent. Introduction of mechanised boats was meant to increase fish production. One would, therefore, expect that the growth of fish production during the period 1964 to 1973 was due to these boats. This is a misconceived notion because even in 1973 the mechanised sector accounted for only 93,660 tonnes of fish, 21 per cent of the catch of that record year. In other words, the growth in fish production was due mainly to the contribution of the one lakh traditional fisherfolk aided by favourable environmental conditions and the most significant technological change in Kerala's fisheries: the shift from cotton to nylon nets.

It is interesting that the mechanised sector became dominant only during the stagnation phase of 1974-1983, and its share of total landings increased to 49 per cent (1.35 lakh tonnes). During the same phase the catch of the traditional fisherfolk dropped from 3.18 lakh tonnes to an all-time low of 1.44 lakh tonnes. Rather than developing a complementary relationship with the non-mechanised sector by fishing in deeper waters, the mechanised boats moved inshore to fish for prawns and earn foreign exchange.

The boat owners and the government point out that June-August are the months when they get the highest prawn catch. They are indisputably correct. If we take the Shakthikulangara-Neendakara region which accounts for the major share of prawn catch in Kerala we see that as much as 70 per cent to 85 per cent of the year's catch is made during these months. However, there is another side to this. Over the years 1973 to 1979 (for which data is available) both the total catch of prawns in this region as well as the catch per unit of effort show sharp declining trends. The catch dropped from 45,477 tonnes in 1973 to 14,582 tonnes in 1979 — a decline of 9 per cent per annum. Catch per unit of effort in the same period dropped from 82 kg per hour to 20 kg per hour — a decline of over 8 per cent per annum. By globally accepted fishery management norms, these are two of the three indicators used to assess overfishing. The third norm — the decline in the size of the prawns caught — is more difficult to establish. However, well informed trade sources point to a shift in the composition of the export mix of penaeid prawns over time from the large (naran, kazhandan) to the smaller varieties (karikadi, poovalan) indicating that the catch pattern in Kerala has also changed in the same direction.

The situation is caused by too many boats chasing too little fish. This is something even the boat owners will agree, perhaps only in private. Due to the absence of any licensing and annual registration procedures the increase in the fleet has been largely anarchic because the resource base is common property.

The most essential regulatory measure required in our prawn fishery is a reduction in effort. This is best done by restricting the number of boats that operate, especially during the periods June-August precisely because these are the peak season months. These measures can only be enforced by a government which has the required political will. Often the plea of governments hesitating to undertake regulation of a fishery is that they lack the finances and the know-how for setting up the required apparatus. It is much easier to get funds for a pilot fishery development project than a pilot fishery regulation project. This, however, is now a thing of the past. Today in the world's largest fishery development agency — the Food and Agriculture Organisation of the United Nations — there is a whole division looking into these matters of management and regulation and having both the financial and technical expertise which they put at the disposal of governments which request it. After decades of failure of fisheries the world over due to gross overexploitation, the need for management is widely accepted. As J. Gulland, one of the world's leading fishery management experts suggests, "reasonable management measures introduced early are better than perfect measures introduced late" The government's role is obviously crucial.

## Destroyer Departments

**L.C. Jain**

There are certain sections of the government which are more vital than others for the promotion and protection of environment: the departments of forest, irrigation, public works and industry. I find that these departments are still blind to environmental issues.

The outlook of the forest department has been completely distorted by the so–called social forestry projects which have considerable international funding support. The social forestry projects have opened several closed doors for forest officials who have been hitherto neglected either with regard to promotional prospects or opportunities for international contacts and travel or funds for acquiring buildings and vehicles. I notice a strong tendency on the part of the forest bureaucracy to resist any criticism or even a suggestion that the policies may be unsound and harmful: for instance, their emphasis on plantations of trees like eucalyptus.

Similarly, the irrigation department continues to construct irrigation headworks and distribution channels without taking fully into account the damage to the soil through waterlogging due to lack of drainage. There is no requirement as yet that no irrigation project can be sanctioned without ensuring that adequate technical and financial provision has been made for preventing any damage to the soil or to the environment.

Government agencies promoting industry continue to be unmindful of environmental issues and the environmental effects of industrial location. Both private and public sector industrial enterprises are obsessed with acquiring some of the most fertile land for plants and for their administrative and residential complexes, except in case where there has been some noise by public opinion. The industrial, promotional and developmental agencies themselves have not been acting as watchdogs of environmental interests. The only area in which the Industrial Licensing Committee is beginning to ask questions is effluent disposal. What precisely is done by these units after obtaining the industrial licence is yet to be monitored and verified. The industrial licensing authorities themselves, to the best of my knowledge, do not carry out any such verification and there are known cases of breach of terms of conditions of industrial licences at the stage of actual implementation.

Most of the favourable environment-related decisions are enacted by those sections of the government which are already innocuous or whose knowledge about and interest in environment is more of academic interest. There is no evidence that government agencies of the kind described above which inflict much damage on India's environment have changed their ways of functioning even in the slightest manner.

## Politics at Land's End

**Sadanand Varde**

Land's End is a lush green area of about 10 acres, lined with beautiful palm trees, overlooking the Portuguese fort and the Arabian sea, at the extreme end of Bandra (west) in Bombay. It was Bandra's favourite recreation spot. In the 1967 Development Plan of Greater Bombay, this land was designated for residential purposes. In 1972, when plans were afoot to construct high-rise buildings on the land, the locally constituted 'Save Bandra Committee' organised a public agitation and succeeded in persuading the state government to direct the municipal corporation, under Section 37 of the Maharashtra Regional and Town Planning Act, to keep the area green; the project for high-rise buildings was stopped.

However, the Muncipal Corporation of Greater Bombay adopted a new resolution in March 1973 removing the green and public reservation, leaving 7,000 sq yards to the local community as a sop. Local citizens went to the High Court. The judge took the view that there was no directive from the government; it was a mere request which the corporation was not bound by law to accept.

In 1976 came the Central Urban Land Ceiling Law. The then municipal commissioner requested the state government for permission to acquire the surplus land — leaving only 100 sq m for the owners — for public purposes under the relevant provisions of the law. However, the then state government led by Vasantdada Patil exempted the land from the provisions of the law and released it for a five-star hotel. This matter is also lying in appeal in the High Court.

After 1977, the Development Plan of Greater Bombay came in for fresh revision. With the cooperation of the local municipal councillors, the municipal commissioner was persuaded to designate the land for public recreation and rejected the building lobby's plans for a five-star hotel. The builders went in appeal to the state government. The commissioner was directed by the state government to consider the plans according to rules. In effect, the government reiterated its earlier decision to permit a five-star hotel and the commissioner's proposal to reserve the entire piece of land for public recreation was set aside. One of the men who supported the builder was Ramrao Adik, minister for urban development.

Local citizens appealed to the Prime Minister, the deputy minister of environment and the Department of Environment (DOEn). Eminent naturalist, Dr Salim Ali personally met the Prime Minister and pleaded the cause of Land's End. The Prime Minister, in a letter to the then chief minister to Maharashtra, Vasantrao Naik, categorically stated that this was the kind of land that should be kept entirely unspoilt and unbuilt for public recreation. An official of the DOEn also visited the site.

But little came of all this. The DOEn sent no directive to the state government and did not intervene to stop the development of the land for a five-star hotel. Plans for the hotel (up to the plinth level) have been approved and commencement certificate granted, but work at the site has stopped. If Bandra loses Land's End it will be primarily because both the state government and the DOEn have supported the builders and cared little for local citizens.

## Missing The Wood For The Trees

**Ashish Kothari**

In a specific issue-by-issue or place-by-place analysis, the answer to the question whether the government is playing a positive role would be both yes and no: it would be yes for Silent Valley and no for deforestation in Goa. But at a more fundamental level, the answer is definitely no.

Most officials we met on our Narmada trek and at Amarkantak (including, for instance, those of the irrigation department and the mining companies) agreed that the environment must be conserved. But how much do they believe in what they say? Often I get the feeling that their statements are mere lip service, necessary ever since the highest authority in the land began expressing concern.

Our study on Amarkantak revealed very clearly the level of consciousness, the genuineness of belief, and the willingness and ability to act of government officials. All officials involved with Amarkantak are aware that the environmental situation there is becoming increasingly worse, and that this is undesirable. This was admitted to us individually by three members of the Special Area Development Authority (SADA) which looks after Amarkantak. Yet in its plans for the plateau's 'development', SADA has no provision whatsoever for safeguarding the environment, nor for providing sustainable benefits to the area's tribal and peasant population. Obviously SADA's members hardly believe in what they say, at least in what they said to us. One member who does seem to care was apparently unable to influence the others.

On the other hand, the mining companies operating on the plateau are having a hard time getting extensions of their leases. Someone in DOEn obviously does care about the forests that will be destroyed if extensions are given. But the forest department is hardly bothered. There are just two guards to patrol a few thousand hectares. There are serious allegations about illegal felling.

However, I seriously disagree with the view that the main problem is the government's ineffectiveness in implementing various laws. There is a far more fundamental issue: whether the process we have embarked on can be called 'development' at all. I firmly believe that it cannot, and unless there is a radical change in our thinking and acting, we cannot avoid environmental disaster. The Indian government is today as firmly, if not more, stuck to the notion of development consisting of increasing industrialisation, commercialisation, consumerism, and syntheticisation.

There is hardly anyone in the government, who questions the process of 'development' that has been thrust upon the common person. Nor do those who influence the government from outside, including the class to which most members of Kalpvriksha, Centre for Science and Environment, Environmental Services Group, World Wildlife Fund etc belong, for that is the class which benefits from this process. Rather, where such questioning is beginning to occur, it is dismissed as foolishness: "What? You want to go back to the Stone Age?"

In this kind of a situation, I think it is of very limited use to talk about the government's role in environmental management and change. Such a piecemeal role as it is playing, or claiming to play, today can patch up a few things here, avert disaster there, and reduce suffering elsewhere, but it cannot provide any lasting solution.

What ought to be its role? This is obviously a difficult question to answer, but I guess a few points can be made:

—As an immediate step, of course, strict implementation of the various laws and regulations.

—Formulation and implementation of comprehensive policies, for instance, on noise pollution.

—Opening up of the vast information network. The government must show readiness and eagerness to provide the public with all sorts of information on environmental issues including, importantly, that on nuclear energy programmes in India.

—Support to, rather than discouragement or oppression of, those NGOs and individuals working on alternatives to the present system (including alternative agricultural techniques, energy projects, irrigation methods). Simultaneously, all the alternatives known to the government for any project must be explored and publicised before the project is taken up. Public involvement and honesty in planning are crucial.

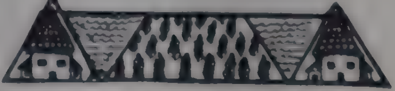
—Greater sympathetic understanding of the views and cultures of minority/disprivileged groups; acceptance of the validity of widely differing worldviews/cultures/technologies; and rejection of a unidirectional path to development.

—Finally, following the above, a questioning of the path already taken and its long-term consequences and implications, exploration of alternative (traditional and modern) paths, including the possibility of decentralised administration.

The Department of Environment is a good step, but nowhere near adequate. Individually, many of the officials are highly sensitive and concerned; as a unit, however, it does not seem very effective. For one thing, it is squandering large resources on unproductive things like seminars. DOEn claims to be open to NGOs from anywhere in the country, but makes little effort to itself find out their needs, especially in the case of those NGOs far from Delhi. Unable thus to spend all the money given to it, it has to bring out thousands of sets of glossy and mostly inane posters, or sponsor extravagant talk-shops, or for glossy computerised NGO directories.

The second problem is its lack of clout. It has hardly any impact on other departments and ministries of the government. Unable to stem the rot, it attempts to justify its existence through ecodevelopment camps, by wooing NGO's through specific research projects and, of course, through publicity and public relations.

If at all any process of change, of basic orientation has to start within the government, it would most likely start with the DOEn. At least it should, for only DOEn and possibly the Planning Commission are in a position to adequately judge the suicidal nature of the present 'development' process. There is, however little sign of such a change.



## Convincing Unconcern

**M.K. Prasad**

It would be a grave mistake to think that the government has become environment conscious. The DOEn boasts of ambitious plans, but from our experience, it has only shunned action. I can cite many examples: allowing public sector industries to pollute the environment, sympathy for large scale forest encroachers, apathy towards banning trawlers and purse seine fishing in coastal waters, and so on. However I do not forget Silent Valley.

Instead of forming a Department of Environment for Kerala, the existing Department of Science and Technology has been renamed Department of Science, Technology and Environment. In the matter of very vital issues like deforestation or encroachment on forest land, this department didn't utter a single word. Kerala recently faced a strong agitation by country-craft fisherfolk to get mechanised fishing banned in coastal waters. The arguments advanced by the fisherfolk were purely scientific. But the department never seems to have advised the government.

Even now the government is sanctioning new industries without any environmental impact assessment. Public protests against polluting factories are ignored. There are instances of the government interfering in proceedings against a state-owned industry. The State Pollution Control Board was to prosecute the Titanium Products Ltd at Trivandrum for not complying with the board's instructions. But the government issued a directive to withdraw the same.

## The Biosphere Challenge

**S. Santhi and S. Sathis Chandran Nair**

Intact natural ecosystems have become small islands in this vast subcontinent. Even if these natural areas are protected with large monetary inputs and political will, they cannot remain viable biologically in the long run and retain their characteristics in isolation in a subcontinent subject to serious land degradation. As the well-being of the people depends on the well-being of the land and its resources, conservation can be effective only if complemented with programmes to meet the basic needs of the people through ensuring the sustained productivity of the lands.

This basic truth should be understood and the Department of Environment must give time to setting up biosphere reserves throughout the country. This will not only protect the remaining natural forests from total destruction, but also act as model welfare projects for the majority of the people in the area. So far there have only been ad hoc attempts to protect select areas or habitats through sanctuaries, national parks and Project Tiger reserves. There is need now for a new national policy aimed at the conservation of the total biological heritage of the subcontinent, which should also include cultivated varieties of traditional crops, indigenous strains of domesticated animals, tribal lifestyles and the expertise of traditional artisans in addition to natural ecosystems. A new system of management also needs to be evolved in which the people play an active role.

The concept of biosphere reserves, initially propounded by UNESCO in 1970, promoted by the National Committee on Environmental Planning and Coordination and later entrusted to the Department of Environment provides the ideal model for achieving these objectives. Relatively unmodified natural areas remain today only in inaccessible and ecologically vulnerable locations. The eastern and western Himalayas, the Western Ghats, the Andaman and Nicobar group of islands are examples. Any attempt to conserve the biological wealth of these areas and meet the needs of the people in an ecologically sound way requires an understanding of the land and its resources and a carefully conceived policy of resource management taking local conditions fully into account.

An integrated approach to rural development must be planned on the basis of composite natural unit areas such as entire river catchments and not as at present through mutually exclusive compartmentalisation of developmental activities. All developmental activities should therefore be implemented only after all the social, economic and ecological impacts are taken into consideration. The biosphere reserves should function as working models for integrated rural development, taking into account all aspects of natural environment, under one authority with a scientific land management policy.

The potentially immense human energy available in India needs to be channelised into the productive, ecological restoration task of massive afforestation. Biosphere reserves can play the crucial role of experimentation in buffer zones where plantations adjoin protected natural forests and serve to shield the latter from destabilising influences and exploitative pressures of the needy poor. In the long run, when the people come to enjoy the tangible benefits of protecting nature through participatory effort, they will truly be convinced of the need to protect the biosphere.

The biosphere reserve model of development should diverge substantially from technology-oriented development in favour of a policy which conserves and carefully husbands the basic resources of soil, water and biota with the total participation of the society for its collective well-being. The whole country must eventually become a biosphere reserve and the world a true biosphere where humans are once again an integral component of an intricate self-sustaining system and not self-destructive exploiters.

## Sharing and Caring

**S.R. Hiremath**

The government is becoming more environment conscious, thanks to the efforts of the media, voluntary organisations and grassroots groups. But how much of this consciousness is reflected in the government's decisions is a big question.

In our own case, the Transnational Centre for Non-Violent Social Change (TNC) in collaboration with development organisations like the India Development Service (IDS) and the Institute for Youth and Development (IYD) organised a 12-day environment camp in January 1984 in four villages on the banks of the Tungabhadra river. It helped increase the awareness of the villagers, the participating government officials and others about a major pollution problem faced by over 100 villages and the town of Ranibennur.

The state government gave a grant and allowed teachers to participate. This camp encouraged villagers to take action when a major fish kill took place in February 1984 and the people helped by TNC and IDS took up the issue. The pollution control board and the government both responded, though temporarily. It needed a lot more follow-up and persuasion from us for the government to take further steps.

The government of Karnataka has a Department of Ecology and Environment which has been very supportive of educational programmes on environment. The government contributed funds for our camps in Gujarat and in Karnataka. Officials visited the Karnataka camp. The government has again sanctioned funds for one more camp on environment and rural development; the focus is on what affected persons can do. It is also promoting community science-cum-environment centres. Even though there is ambivalence on the part of some officials, the higher officials at the district and state levels, especially IAS officers and some scientists seem to be helpful. The fisheries department, for example, has undertaken a study in collaboration with us. The government is also considering our proposal for a study of pollution in Tungabhadra. However, the state pollution control board has been reluctant to share information and is giving out only nonsubstantial information after a lot of pressure.

The only experience we have had with DOEn in New Delhi is for a proposal for a pollution study. Even though several well-known scientists of Karnataka will be associated with the proposed study as well as well-known environmentalists in and outside Karnataka (like Dr Madhav Gadgil and Dr S.B. Chaphekar), the DOEn did not show much interest in this. The first comment the DOEn official made was that this would be a controversial study — perhaps because it involves pollution by a Birla firm — and also that the referees of the DOEn are traditional scientists who would not be favourable to action-oriented research or studies. Therefore, the experience with DOEn was rather disappointing and the officials clearly seemed not to understand the needs of the poor like fisherfolk who are worst affected by fish kills and gradual depletion of fish and adverse impact on the health of people and cattle. The DOEn tried to evade its responsibility by referring us to the state government.

Neither the Central nor the state government has a clear idea of the needs of people dependent on the environment for their survival because most government officials are not in close touch with such people. We in the voluntary sector are doing our best to identify and get concerned government officials involved. The process is very slow. While some sensitivity is developing towards the environmental needs of the disadvantaged groups, it still has to go a long way to be reflected in practice.

We feel that the thrust of the government, whether at the national or the State level, with respect to voluntary agencies should be mainly in the following areas:

—Making scientific and administrative information available to environmentalists and grassroots groups; a freedom of information law is a must.

—Help grassroots groups undertake studies on effects of environmental degradation on marginal groups. The government should provide financial support as well as the help of its technical officials.

—Have regular sharing and exchange of environment-related information with grassroots groups, especially their experience with environment-dependent groups so that it could be taken into account while formulating policies and developing programmes for marginal groups; this may be conveniently done in a forum like the Federation of Voluntary Organisations for Rural Development in Karnataka (FEVORD-K) and also the consultative committee of voluntary agencies recently formed in Karnataka where high-level government officials and activists of voluntary agencies meet regularly.

## Towards Human-oriented Change

**Mohan Hirabhai Hiralal**

A development process that is in harmony with the environment ultimately demands a new culture. Any individual, association or organisation which shows signs of moving towards such a culture can be called an agent of change. There are several things necessary for becoming an agent of change in a human-oriented direction. Means ought to be changed regularly to keep them in harmony with ends. There should be a readiness for self-evaluation at every step and to change as required. There should also be an openness to criticism and evaluation by others and a readiness to learn from each other's experiences. Persistent efforts should be made to change the style of working for the people to working with the people

Several non-governmental and governmental activities are steps towards the new culture: the Chipko Andolan in Uttar Pradesh, the Silent Valley and the Chaliyar River movements in Kerala, the preparation of the parallel report on the Bedthi dam and the Appiko movement in Karnataka, the Fisherfolk's movement in Goa, the Bodhgaya Land Struggle in Bihar, the Mitti Bachao Andolan in Madhya Pradesh and the nationwide protest against the Forest Bill.

Among governmental activities, we can list the Employment Guarantee Act of 1978 of Maharashtra, the scheme for afforestation of treeless forest lands by poor and unemployed people undertaken by the Maharashtra government and similar afforestation schemes launched by the Gujarat government.

The Employment Guarantee Act provides for the undertaking of programmes that will guarantee employment within 15 days of being demanded by any adult villager and for the setting up of an adequate Employment Guarantee Fund through special taxes levied on those who already have employment.

The Maharashtra afforestation scheme aims at helping people to meet their primary needs and at the same time to increase the green cover. Some special aspects of this scheme are:

— two hectares of forest land and Rs 150 per month will be given for five years to any poor and unemployed person undertaking afforestation; mixed forests will be planted which will provide fruit, fodder, fuel, bamboo and small timber; and,

— when the timber is felled, half the profits (after expenditure being deducted) will be shared with the person planting the trees.

The above example of government activities ought to be seen only as a step forward. Change does not take place simply because a law has been enacted or a scheme has been formulated. Such schemes and laws cannot succeed without the conscious participation of the people.

The Employment Guarantee Scheme (EGS) in Maharashtra was formulated to give concrete shape to the Directive Principle of the Right to Work but implementation has been in the nature of famine relief works. The state has not shown adequate political will to implement this act in the spirit of the principles on which it is based.

But wherever social workers have tried to persuade landless workers and small farmers to make use of this act, good results have been obtained. Women have benefited most. About two thousand farm labourers from Desaiganj area of Gadchiroli district filed a petition for the implementation of this act. The court has admitted the petition and people are trying to fight at every level.

The Indian Federation of Building and Wood Workers has demanded that only those activities should be undertaken under the scheme that will help to develop sources of production so that instead of temporary relief-type employment, as on road building, regular employment can be obtained. They have suggested that EGS should include the scheme for afforestation of treeless forest lands and every person seeking employment for 10 years should be given the job of afforestation under this scheme. The scheme should include programmes for teaching skills to farm labourers. The government should make available some temporary employment with appropriate daily wages even for the 15 days within which it is expected to find a permanent job for an unemployed person. The workers have suggested that among the various types of activities on which people can be immediately employed is spinning on the ambar charkha.

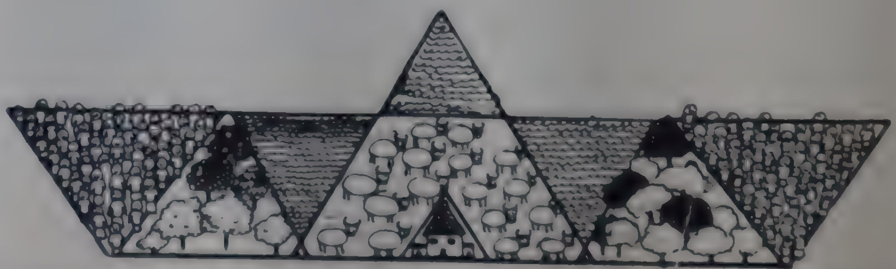
The scheme for afforestation of treeless forest lands by poor, unemployed persons is based on good principles but the government is not serious about its implementation. The forest department is completely against it because it does not want to part with any forest land under its control. Moreover, only teak trees have been given for planting.

Individuals involved in this scheme have not been made fully conscious about its basic principles. They simply consider themselves government employees with a wage of Rs 150 a month.

It was proposed at a high level meeting of conservators of forests that the scheme should be wound up because the people have not shown any interest in it. Several unemployed people from three villages of Gadchiroli have given applications for undertaking afforestation under this scheme but no attention has been paid to their applications.

The state's forest department has also formulated a scheme to develop a pasture in 125 acres of treeless forest land between two villages of Gadchiroli district. Koregaon's poor landless labourers and small farmers have welcomed this scheme. But their suggestion that portion of the pasture should be given to them for conservation and management has yet to draw a response.

In total disregard of the Forest Conservation Act of 1980,



extensive forest areas are being cleared in tribal areas of Maharashtra. The government has made plans to build a series of 21 dams which will lead to a cultural annihilation of the Maria Gond tribals.

Several people of the Jungle Bachao, Manav Bachao Andolan are planning to undertake padayatras to increase people's consciousness. People from one village, with torches in their hands, will carry a mahua sapling to another village, where they will plant the sapling and hand over the torches. The next set of villagers will then undertake a similar journey to yet another village. Meanwhile, social workers will discuss land, water, forests, hunger, employment, fuel, administration and various other issues with the villagers.

## Now You See It, Now You Don't

**K. Ramakrishna**

Andhra Pradesh was one of the first states to create a department exclusively for energy, environment, science and technology. This was in February 1982. In September 1984, it also became the first to wind it up. The department was born in T. Anjiah's regime and was put to sleep during the infamous rule of usurper N. Bhaskara Rao. The department's departure went unnoticed.

The initiative for the department's creation came from the bureaucrats. It began functioning with a secretary, also designated ex-officio chairperson of the Andhra Pradesh Pollution Control Board, and a small unit of officers. The department decided that its initial role ought to be to sensitise people both at the decision-making and the general level. It never attempted to direct activities or demand an effective say in implementation. Even then it needed sufficient resources and a certain flexibility to became creative. But other bureaucrats, particularly many senior ones, were not impressed, arguing that it was discharging an inadequate number of files per day to be a full-fledged department and the work could as well be done by officers looking after other departments. Their opinion prevailed and the department was split into three units with the environment section transferred to the ministry looking after municipal administration.

The bureaucracy in the Union Department of Environment (DOEn) had a role to play in the winding of the state department. The officials heading the state department had realised early on that there was little political appreciation of the need for environmental conservation. They felt, therefore, that by devising schemes that would cost the state exchequer little but yield significant results could help to develop an interest among local politicians. This they attempted to do with financial assistance that was promised to them by the Union DOEn. But their experience was unhappy.

The state department had wished to celebrate World Environnment Day by conducting essay competitions, seminars and debates but in a way that would involve the public at the district level. District collectors were promised a sum of Rs 2,000 for these programmes and it was hoped some Rs 50,000 would be provided by the Centre. After the programme was launched and successfully completed, the state department was told that it might not be possible to provide the promised sum. After much unpleasant correspondence, the matter was resolved and the money transferred.

The state department also came up with a scheme to build a common effluent treatment plant in Nacharam Industrial Estate in Hyderabad. After a good deal of persuasion, the department was able to get the local industries to bear half the expenditure. For the remaining half the state department approached the Centre, but was disappointed. Similarly, a request made to the Union DOEn for a grant to cover office expenses to service the state-level environment committee was turned down.

Officials in the Central department do point out that Andhra Pradesh was one of the few states which had taken the initiative to make such requests. But they were afraid that once money was disbursed to one state, other states would also make similar requests and it was not possible for the Centre to cope with such expenditure. The state department thus found itself in a financial drought and got washed away in the political flood of Bhaskara Rao.

## Voices

### KERALA

Our Kerala government does not bother about the environment. The government, whatever colour it has and whatever combination of parties it consists of, thrives on forest plunder. There are a few political parties here with two or three members in the state assembly. They will be in power whichever party comes to lead the government. An example is R. Balakrishna Pillai, our power minister, who even now goes on saying that he will bring about the Silent Valley Hydel Project. The Kerala Congress — all factions — are keen on forest encroachment. The Muslim League — both factions — are interested in timber. No party has clean hands.

**— John C. Jacob, Society for Environmental Education in Kerala, Cannanore.**

Even when governments become aware of problems they prefer to sidetrack issues. An example is the recent fisherfolk's agitation in Kerala. The poor fisherfolk were demanding a total ban on mechanised boats for four months of the breeding season. The Kerala government instead announced welfare schemes like scholarships for fisherfolk's children and free housing.

**— Pandurang Hegde, Appiko movement, Sirsi.**

### RAJASTHAN

Our experience with the government in relation to the issue of deforestation in the Aravalis shows that as a consequence of Sunderlal Bahuguna's visit and his efforts in Jaipur, both with the officials and the press, we have been able to elicit a good immediate response from the government. In the forest department in Rajasthan there is a young cadre of officers at different levels who are deeply concerned about deforestation. Some of them are also beginning to recognise the legitimacy and necessity of people's interest and involvement. However, the basic policies and the system need some fundamental changes in outlook and performance.

A department of environment has been set up only recently. It is still in the process of defining its role. The already existing water pollution control board and other agencies have not been particularly effective. Given the situation of widespread and serious degradation of the environment, the department has an important role in creating a sense of crisis and urgency among all concerned. So far the environmental problems of Rajasthan lack clear definition, and therefore no proper policy formulation has been done.

**— C. Kishore Saint, Udaipur.**

In my state, a department of environment has recently started functioning. It is being run by a forest officer. An environment board has also been formed. To our surprise, it consists of MLAs, ministers and two or three others. None of them can claim to know much about the state's environmental problems by any standards. Policies are in the offing, I believe.

**— S.M. Mohnot, University of Jodhpur, Jodhpur.**

### MADHYA PRADESH

The Madhya Pradesh government's policy towards the environment can be gauged from the fact that it set up the Environment Planning and Coordination Organisation (EPCO) and an environment complex, both of which have had several changes in leadership already. EPCO launched a state of the environment report but that has yet to be published. Instead EPCO is now bringing out publicity brochures for tourists to visit scenic spots in Madhya Pradesh, and the environment complex is only noted for its construction activity and the surge for employment in its various offices.

**— Dunu Roy, The Shahdol Group, Shahdol.**

The Madhya Pradesh administration had announced an 11-point environment policy on June 7, 1982. It was pointed out in this statement that EPCO would present a report on the state of the environment to the state assembly every year. More than two years have passed since that announcement was made but no report has yet been presented. In a letter that I had written to the Indore daily 'Nai Duniya' entitled "Give us the news of implementation as well", which was published in December, 1982, I had argued that as one year is too small a period for environmental improvement but too large a period for environmental destruction, EPCO should present a report on the implementation of the environment policy in every session of the assembly.

Similarly, in September 1979, the Indore Municipal Corporation had announced that it was compulsory to plant two to three trees in front of every new building. All that the corporation has done since is to stamp the 'no objection certificate' with the statement that "It is compulsory to plant trees on the land". No official has, however, found time to see how much heed has been taken of this order. Why do we make policies and rules which we cannot follow-up?

**— O.P. Joshi, Indore**

### KARNATAKA

Though we cannot say much about the Karnataka government's environment policy as a whole, the forest policy as such is far more progressive than other southern states. But it is only the policy which is good. In actual implementation, these policies are forgotten. The state government run by the Janata Party claims to be Gandhian and dedicated to decentralised rural development. So it sets up mini-cement plants in the midst of evergreen forests in the Western Ghats, and it allows the setting up of more plywood and paper mills which will use more forest resources. The government publicises social forestry and school forestry. But there is nothing but big publicity. Real issues are rarely touched.

**— Pandurang Hegde, Appiko Movement, Sirsi.**

### MAHARASHTRA

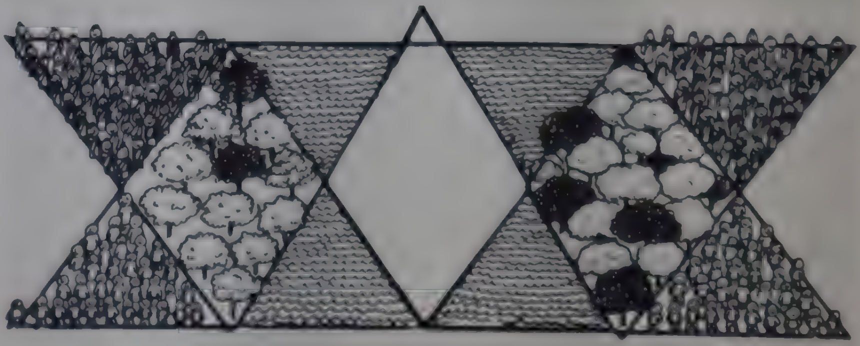
The environmental policies of Maharashtra are limited to pious statements and a few fancy projects like developing wildlife sanctuaries. No efforts are made to check air and water pollution or to protect natural forests.

**— Sharad Kulkarni, Centre for Tribal Conscientisation, Pune.**

### NEW DELHI

Taking Delhi as a centrally administered territory, I have to say reluctantly that I don't think its administration has even marginal environmental awareness. Undoubtedly, the aesthetics of central Delhi make it one of the most beautiful capitals in the world. There is much talk of "tree planting" every year but survival is poor and species ill-chosen. In every other respect, the lack of any effective environmental programme is the antithesis of the national policy: polluted air, a practically poisoned river, endangered groundwater, inadequate sewerage and sewage treatment, dangerously high noise levels in many areas, and expanding slums.

**— Sunil Roy, New Delhi.**



# VOLUNTARY ACTION

The number of voluntary groups in India actively interested or involved in environmental issues today is larger than in any other Third World country and probably matches the numbers found in Western countries, where the environmental movement had its beginnings. Except for certain conservation-oriented groups and groups interested in protecting the urban environment, it would probably be accurate to say that most groups in India cannot strictly be called environmental groups in the Western sense. This is particularly true of grassroots voluntary groups in rural areas, whose existence and number lends a distinct character to the voluntary movement. Most rural grassroots groups have begun to take up environmental issues in addition to their long-standing concerns for rural and urban poverty, social justice, inequality, civil liberties, rural development, appropriate technology and health. Their perspective embraces not merely an understanding of the human impact on nature but sees this impact as arising out of the complex web of social and political relationships between human beings: what humans do to nature is essentially born out of what humans do to each other.

Harsh Sethi of the Indian Council of Social Science Research says in an article published recently in the 'Economic and Political Weekly' that this increase in interest in micro-organisations has grown out of the failure of the established macro-organisations—political parties, kisan sabhas, trade unions and the government—to do anything about growing poverty, inequality, landlessness, unemployment and centralisation of power, and to bring about positive developmental and participative trends within society. On the other hand the voluntary agencies often concentrate on these problems; they are where the action is, from remote villages to urban slums, dealing with local problems, with local populations. These organisations are definitely non-political in the sense that they do not participate in electoral processes. But most such groups do have a political perspective of the society and its growth, which is sometimes clearly articulated, but more often not.

## NGO categories

Broadly speaking, most voluntary groups—in all, they must run into thousands—especially those working in rural areas, can be divided into four major groups: charity and relief groups, development groups, action groups—some more openly political than others—and support groups—lawyers' collective, alternative professional associations, groups publishing journals, documentation centres, theatre groups. Charity and relief organisations have been forced to ask themselves whether charity can deal with social problems, and this internal questioning is pushing them towards long-term developmental activity, like Oxfam on a global scale and the Ramakrishna Mission on the national level.

Development groups, in turn, are being pushed towards action-oriented work. They often begin by taking up programmes to help the poor increase their social status, incomes and self-reliance in basic needs like energy and health services. In many cases, these groups supplement official efforts for development. Often they consist of middle class professionals who have opted out of lucrative careers to undertake rural development work.

But no matter how committed or innovative they may be, they face serious limitations. Most of them are small and operate in restricted areas. While this facilitates flexibility and a deeper knowledge of the local area and people, it also limits the range and type of activity. Moreover, local bigwigs, bureaucrats and politicians often frustrate attempts at honest work. Local vested interests become hostile as they sense that the organisation will no longer toe the line. The more politicised of the group members see their activity as futile and become cynical and disheartened or leave for a more explicitly political group, or continue ineffectually where they are. The 'technicists' too, lose out in the process, and very often return to more conventional jobs. This loss of cadre finishes off most organisations. Some make fervent attempts to replace the external middle class professionals with local cadres. But such cadres fail to attract funds from external sources to continue the programme, and programmes of this sort, with salaried personnel can rarely be funded out of local resources.

### Chipko experience

The Dasohli Gram Swarajya Mandal in Gopeshwar, which pioneered the now world-famous Chipko movement, is a group which progressed from development work to activism, and typifies the story of most development groups.

Disturbed by the increasing poverty in the hills and the steady migration to the plains, a few young men of Chamoli got together in the early sixties to organise a cooperative labour society so that hill labourers could not be exploited by unscrupulous contractors. They started seeking contracts with the public works department and were able to double the wages of their members. In 1964, they formed the Dahsoli Gram Swarajya Sangh (DGSS) to start cottage industries based on the natural resources of local forests. Together with eight other local village cooperatives, they set up a factory based on the use of pine resin with the help of the Khadi and Village Industries Commission but the forest department refused to supply these factories with enough pine resin. Even the price was higher than the price at which the state government's own massive factory at Bareilly got pine resin. Village factories, thus, lay idle.

DGSS workers soon realised that they had no rights or control over local forest resources, even though they could see their unscrupulous exploitation by rich contractors in collusion with the government. They also witnessed the massive overexploitation of the herbal wealth of the region in which contractors were not only driving herbal plants to extinction but also cheating the people by paying them a petty fraction of what they would themselves earn from the market. DGSS workers went from village to village telling people about the right prices of these herbs. Remembers Chandi Prasad Bhatt, who gave up a clerical job in a bus company to found DGSS: "All during the 1960s we would run from the hills to the state capital Lucknow to plead our case before government officials there. But finally we saw the futility of this exercise. It would take years to convince an official and then he would get transferred. We would begin afresh with the new one."

Soon, the DGSS became more militant. The revolutionary spark came when the forest department denied the people the traditional ash wood for making the yoke for bullock ploughs but readily allocated it to a sports goods manufacturer. The events that followed are now well-known as the Chipko movement, which got ready support and participation of almost all sections of the hill population.

### Development work

However, this trend towards activism amongst development-oriented voluntary agencies does not mean that development work by itself is useless. In fact, voluntary agencies have made significant contributions in working with neglected sections of the population and neglected issues, in responding to problems faced by local populations in local situations, and in developing new and democratic methods of operation. The latter contribution is probably the most important. These groups have shown the way towards experimentation with alternate ways of doing things like organising cheap and people-oriented health services. The successes of groups working in the field of health care, appropriate technology, water management and afforestation have forced professionals in these fields to debate their own approaches and solutions. The Medico Friend Circle, a coalition of highly innovative groupss working in the field of health care, has tried to generate a major debate within the medical profession. In the field of environment, the afforestation work of the Chipko movement is today noted at all levels of government.

But even though the innovative work of voluntary agencies gets widely noticed, the ensuing debate has usually not lead to any major change in the ways of the government or of the major professions. The World Health Organisation, for instance, picked up the concept of primary health care from the work of some excellent grassroots health groups, but its programmes have not yet gone much beyond lip service. Even the few government programmes modelled on the concept of primary health care remain riddled with inefficiency, contradictions and inadequacies.

But what this publicity does do is to attract many more middle class professionals to development work and sometimes to development activism directly, leading to a growth in voluntary activity itself. It is no longer rare to find many students from premier institutions like the Indian Institutes of Technology or the Indian Institutes of Management keen to work with voluntary agencies on development activities.

The highly publicised success of voluntary agencies on one hand and the trend towards activism on the other has resulted in a double-faced government response. While on the one hand government agencies have been showing increasing interest in involving voluntary agencies in development programmes, on the other they are wary of them and want to bring them under control, specifically by regulating their sources of funds. In October 1982, Prime Minister Indira Gandhi had sent out a circular directing government agencies to involve voluntary groups in anti-poverty and minimum needs programmes. She suggested the formation of consultative groups in all the states, to be chaired by the state's chief secretary or development commissioner. In April 1983, the National Development Council, which consists of senior Central ministers and chief ministers, accepted a paper on public participation in development programmes which recommended the involvement of voluntary agencies as the eyes and ears of the beneficiaries of poverty-oriented government programmes.

### March of Hope

**Alarmed by the destruction of the Himalayas, a group of activists lead by Sunderlal Bahuguna walked 4,870 km across the Himalayan range, from Kashmir in the west to Kohima, the capital of Nagaland, in the east, in a marathon voluntary effort to educate the people. The marathon began in May 1981 and ended in Februrary 1983. It took in Jammu and Kashmir, Himachal Pradesh, Uttar Pradesh, Nepal, West Bengal, Sikkim, Bhutan Arunachal Pradesh, Assam and finally Kohima.**

**The walkers had a grim story to tell. Bahuguna says: "Streams have dried up, hills are denuded and a desert is spreading fast from the middle Himalayas to its southern foothills." Every year landslides across the Himalayas wipe out complete villages, claim many lives, and destroy agricultural land. Converted into monoculture plantations, the forests no longer meet the people's needs of food, firewood and fodder.**

**Except in the Kashmir Valley, Bhutan and small pockets of Arunachal Pradesh, there was an acute shortage of drinking water. In the Uttar Pradesh hills, for instance, there has been a steep 60 per cent to 70 per cent drop in water supply. As one of the walkers said: "We could see village women standing in long queues to collect water from fast disappearing water sources." Government schemes to supply pipe drinking water are foiled when, after completion of the scheme, the source dries up. The flow of rivers has become very irregular, and hydel schemes also suffer. The activists were told that the Salal power project over the river Chenab in Jammu and Kashmir, will have water for only 151 days in a year to keep all its turbines running.**

**The fuel shortage is dramatic. Women travel long distances to collect fuel and fodder. Children collect firewood instead of going to school. In Kashmir women are driven to sweep up willow leaves to burn in their stoves. When the walkers asked villagers in Nepal where they got their fuel from, the answer was; "Earlier there was no problem, we had twigs and branches. Then we used refuse from saw mills. Now we are using the stumps and some day we will dig up the roots." With fodder, fuelwood and water becoming scarce, and the land too poor to feed the people, the young and able are leaving the hills to look for jobs in the plains. As Bahuguna says: "Men follow their soils". With men leaving, women have to bear an increased burden.**

**Commercial exploitation is the root cause of the growing disaster. In Jammu and Kashmir revenue from the forests has increased from Rs 85 lakh in 1947 to Rs 40 crore in 1981-82. In Himachal Pradesh 85 per cent of total felling is for commercial**

The Planning Commission has hired a leading figure in the voluntary sector to work as a consultant on the involvement of voluntary agencies. A meeting called by the Planning Commission of select voluntary groups pointed out that voluntary agencies have a crucial role to play not just in traditional areas of social welfare like disaster relief and child care but also in professional areas like forestry, agricultural research and education, rural development, alternative sources of energy, non-formal education, housing, urban development, water supply and sanitation, women's development, development of scheduled castes and scheduled tribes, science and technology, environment and ecology. There is also a move to include an entirely separate chapter on the role of voluntary agencies in the Seventh Five Year Plan document.

Within the Department of Environment, the Rashtriya Paryavaran Salahkar Samiti (National Environmental Advisory Committee), set up to replace the former National purposes. The Chenab Valley of Jammu and Kashmir has become a big graveyard of fir, spruce and other conifers. According to the walkers, "we could see lumbering companies busy chopping down trees and saw mills busy functioning inside the remote forests."

In Himachal Pradesh negotiations are on for a plywood factory which will need 50,000 cum of timber from the catchment area of the Yamuna. The West Bengal Forest Development Corporation proposes to establish a newsprint factory in the Darjeeling forests and for this about 10,587 hectares has been allotted to the pulpwood working circle. In southeastern Arunachal Pradesh there has been a sudden explosion in the number of saw mills, plywood and veneer factories. Even though in Arunachal Pradesh and Nagaland forests are owned by village communities, big industries are creeping in to plunder. An Arunachal Pradesh minister sounded a grim warning, "if the trends continue there will be no forests in Arunachal in 10 years". The destruction continues in other areas of the eastern range, in Sikkim and Assam.

The report of the footmarchers highlights the nexus of forest officials, contractors and politicians. In Himachal Pradesh timber distribution rights are granted to local people for house construction. In theory these cannot be sold but with the forest guards bribed into acquiescence, it is estimated that almost half of the timber cut comes into the market through private forest contractors, saw mill owners and other sources. The walkers discovered that only 15 per cent of the annual cut goes to the right-holders. They met individual timber right-holders who had been unable to get wood for the last five years.

This hunger for wood has lead to the conversion of large tracts of mixed natural forests into monoculture plantations. "Saw mills have turned natural jungles into timber mines," say the footmarchers. All along the route the travellers saw broad-leaved species being replaced by fast growing trees. The walkers feel that this is the main cause for poverty in the area, for the scarcity of water, fuel, fodder, and soil erosion.

Other enterprises contribute to the slaughter. In the Himalayas construction of motor roads has top priority, but wherever these roads go, trees disappear. The walkers cite examples where roads have been built for no other purpose than to extract timber: in Himachal Pradesh the road between Chamba and Chewra serves only to transport fuelwood to Chamba. The limestone quarries of the Doon Valley, the magnesite quarries of Kumaon, slate quarries of Dharamsala and dolomite in Bhutan have also wreaked havoc.

Committee on Environmental Planning, consists mainly of representatives from voluntary agencies to keep the government informed about people's problems and emerging issues. The department has also published a theme paper on India's Action Plan for Wildlife Conservation and Role of Voluntary Bodies.

But not all voluntary agencies are happy with being the ears and arms of government agencies or their more efficient extensions. Their activisim bothers the government which wants to control their funding sources. In early 1983 income-tax concessions given to industry to support rural development work by voluntary agencies were withdrawn. Instead of direct donations from industry to voluntary groups, the Central government set up a National Rural Development Fund under its control, through which all industrial donations had to be routed if industrial firms still wanted to avail of the tax concessions. To date, that body remains a non-starter. While the government argued that industries were misusing these tax concessions to siphon funds for other purposes, many in the voluntary sector saw in this merely a step towards taming them.

In late 1984, the government took another step to tighten up the provisions of the Foreign Contributions (Regulation) Act, 1976. Sevanti Ninan and Kalpana Sharma pointed out in an article in the 'Indian Express' that though the amendments to this act appear to be aimed at political parties and to have arisen from the situation in Punjab, where large quantities of funds have been coming in from foreign sources for anti-national activities, "on a closer reading it is clear that the action is also aimed at the voluntary sector". All organisations receiving foreign funds were earlier expected to inform the Home Ministry about each foreign contribution they received and its origins. But the new rules make it mandatory for all organisations receiving foreign funds to first register with the Home Ministry before they receive such funds or, if they are not registered, to seek prior permission before they accept any foreign donation. The changes also bring within the ambit of the act smaller voluntary groups which were not funded directly by foreign donors but by intermediary voluntary organisations situated in India which were receiving foreign funds; they will now have to get registered with the Home Ministry if they wish to continue receiving these funds.

These changes have many voluntary agencies worried. As the head of one apex body of non-governmental organisations puts it: "Today we may be in their good books, tomorrow in their bad books. Registration is only the first step in extending control." These steps lay the recipients open to constant harassment by district-level authorities and provides a handle for criticism to vested interests in their area of operation.

The worst affected will probably be those very small, localised development groups, often working in inaccessible areas, whose only source of funding so far has been through intermediary voluntary organisations who in turn get it from donors abroad. These groups neither have the inclination nor the physical and administrative capacity to deal directly with the Central government or foreign donors. This level of voluntary work could dry up completely because of the new restrictions. A member of the Kerala Sastra Sahitya Parishad (KSSP) though wary of the motivation of the government, expresses happiness over the new controls on inflow of foreign funds. "The voluntary sector must be forced to look at indigeneous sources of funds," he says; the KSSP accepts no foreign money.

The relationship of the government with environmental groups tends to vary with the groups. Generally, conservation-oriented groups, information and education-oriented groups and even some grassroots development groups, particularly the more well-known ones amongst them, tend to get more funds from the government than those opposing government policies and projects. The creation of the Department of Environment (DOEn) at the Centre has provided some, albeit extremely limited, entry into the government for those groups which oppose specific government projects or policies on strictly environmental grounds. The DOEn, for instance, has tended to support those groups who are fighting the environmental degradation caused by limestone mining in Mussoorie. But those groups who have been opposing certain dams mainly on the grounds of displacement of people, a largely social issue though with some environmental implications, do not find much entry into the government through the DOEn.

This is also because DOE's own limited clout with other government agencies means that it cannot push any broad

## Teaching the Environment

Voluntary agencies are doing for the people what the government cannot do for them: telling them how the environment is being destroyed, who is destroying it, and what can be done about it. There is a major difference in perspective between voluntary and government educational efforts: the government agencies usually end up blaming the poor for environmental degradation while voluntary agencies stress the overconsumption of the elite, government policies, and exhort the people to appreciate alternative development processes.

The finest work is by the Kerala Sastra Sahitya Parishad (KSSP), with over 4,000 members and 250 units across the state. The KSSP uses everything possible to get its message across: streetcorner theatre, mass circulation magazines, lectures, village meetings, songs, dances and campaigns (see SOE'82).

There is a growing number of people's science groups which are also putting environment on their agenda. Though nothing like the KSSP exists in any other part of the country, the Uttar Pradesh Himalayas have definitely been humming with environmental education work. The Dasohli Gram Swarajya Mandal (DGSM) which pioneered the Chipko movement has been organising ecodevelopment camps to bring together groups of social workers, students and villagers for discussions on environmental issues and for undertaking afforestation work. DGSM uses these camps to stimulate an all-round debate on the problems of economic and social development, though the focus remains on the protection and improvement of the local ecosystem for meeting immediate household needs. Ecodevelopment camps are now also being organised by other groups like the Lok Chetna Manch in the Kumaon Himalayas. The Environment Cell of the Gandhi Peace Foundation has assisted in the organisation of several ecodevelopment camps in the Himalayas as well as in other parts of the country.

In Uttarakhand, Sundarlal Bahuguna has undertaken several padyatras to spread the environment message, even walking across the Himalayas from Kashmir to Kohima. More recently, the Uttarakhand Sangharsh Vahini, which has been involved with both the Chipko and the Liquor Prohibition movements, organised a two-month, 900 km footmarch from Askot to Arakot in mid-1984. Public meetings on the way provided an excellent opportunity for spreading environmental awareness in remote areas, and also for the footmarchers to improve their own understanding of local conditions and their contacts. Environmental campaigns have also resulted in excellent environmental education for the public. The Chipko movement, the campaign against the Silent Valley hydroelectric project organised by the KSSP, the Mitti Bachao Abhiyan, the demand to stop the Bhopalpatnam and Inchampalli dams, have all been widely reported in the press and several meetings have been held during these campaigns.

Environment is not an exclusive concern for either Eklavya or Kishore Bharati — pioneering organisation in Madhya Pradesh involved in the improvement of science education in rural schools — but is important for them as they want an education that teaches the ability to examine critically all aspects of the human world: the physical, the social and the conceptual. To popularise science, Eklavya has a poster exhibition called Vigyan Kya Hai which is exhibited at village fairs and other places. In 1983, it assisted the Madhya Pradesh Council of Science and Technology (MPCST) in the preparation of projects aimed at the diffusion of scientific temper in society. It proposed a programme of debate and action within universities, colleges, student organisations and voluntary agencies around the most fundamental problems: fuel, forests and forest produce, pollution, health and irrigation, all closely related to environment.

The Shahdol Group in Madhya Pradesh, formed in 1974 after a team of students had visited the Shahdol district to study the problems caused by the pollution of the river Sone by a paper mill, is also launching a major environmental education programme with the assistance of the Department of Environment. In its report on the development of the Shahdol district — the only one of its kind in the country — the group has analysed in detail the existing human–human and human–nature conflicts.

During the course of its research, the group has also conducted a number of action-oriented educational experiments. Students volunteers had found that tribals collecting and selling mahua flowers are aware of probems like unemployment and lack of credit but not their solutions. The group used flash cards to generate discussions on the problem and subsequently a trade bank was organised with some credit, which tried to preserve the mahua flower from distress sales. Later the bank tried to meet the grain and credit requirements of its members. The groups has also experimented with slide shows, exhibitions and a model vegetables farm. It set up a technical workshop to train local youth in technical skills and analytical methods for understanding social phenomena.

The group is taking up a major educational programme in 40 villages: slide shows, posters, comic books, skits, songs, dances and various other types of media will be prepared and used to expose the people to their immediate environmental and social conflicts and involve them in seeking solutions. Exhibitions of appropriate technologies will also be organised and if responses to prototypes are adequate, commercial production possibilities will also be explored.

In Kerala, another group is working with local voluntary groups and tribals for ecodevelopment. Says S. Santhi, a member of the group, "During the past few decades of modern education and development, the average villagers have been exposed and conditioned by a lopsided notion of progress and development. It is not often easy to get them to see the basic errors in the assumptions made by the advocates of modernisations." Three detailed case studies are being prepared by the group to understand the complex interplay of forces leading to disequilibrium of local ecosystems and to identify appropriate solutions with the help of local activists. One study is on the land use problems in the Altappadi tribal area in North Kerala, the second on the forests of Kani tribals, and the third on needs and problems of reed workers. Booklets, exhibitions and slide programmes have been prepared and used to explain the crisis arising from disintegration of the tribal communities, the reed workers and the agricultural productivity of the surrounding areas. Several voluntary groups have now come forward to undertake conservation measures and a movement is building up against the proposed Vamanapuram Irrigation Project, which will submerge primary forests, large areas of productive agricultural land and displace thousands of tribals, farmers and reed workers.

Meanwhile, the group is also planning a conservation action centre, a kind of self-sufficient model community in Altappadi, a tribal area close to Silent Valley. Afforestation, catchment area

concepts of ecodevelopment other than those issues which are strictly environmental in nature. Several voluntary agencies and environmentalists had participated in the DOEn's exercise to draw up recommendations for the new Forest Policy. Several recommendations were accepted by the department but they did not find much favour with the Agriculture Ministry which is responsible for forests. Arguments on the new Forest Policy continue.

Environmental activities of voluntary agencies can be categorised into three main areas: environmental education, data collection, analysis and information dissemination; mobilising and organising the public directly or through courts and the press to oppose public or private sector policies and projects that could be harmful to the environment or to people dependent on the environment; and activities directly aimed at the amelioration of environmental problems, which is some cases leads to highly innovative models of resource management and protection, fuel plantations and diversification of food crops — not cash crops — are ideas being mooted to provide employment and initiate habitat restoration. To involve and educate the local tribals, booklets, folk songs, plays, short movies and posters are being prepared. Santhi hopes that "within a few years we will have living proof: a rejuvenated stream." To develop an ecologically suitable method of agriculture, seeds of local cereals, vegetables and trees are being collected and grown. Meanwhile, detailed land use studies of the Altappadi plateau are being carried out. The public awareness programme began with a two–day open camp in 1983, soon after popular agitation was successful in saving the Moochikund forest from politically backed illegal felling. With the help of the panchayat leaders who led the agitation, nature clubs are being formed in schools and a few teachers have come to assist in the setting up of the community centre.

Several agencies are working with urban schools and colleges. An interesting experiment was carried out by the Vikram Sarabhai Community Science Centre in Ahmedabad, which as far back as 1971 organised groups of high school and college students to collect and analyse data on local environmental conditions and needs. Groups were organised, for instance, to collect data on the pollution of the Sabarmati river and the environmental changes taking place around it and to study respiratory diseases and traffic patterns. Members of Ankur, a Delhi–based voluntary agency have started taking a few courses on environment in local schools. The entry point for Ankur is the course on socially useful productive work (SUPW) that has been introduced in all schools of the capital. But it is not smooth sailing for Ankur; whether its workers can teach during the SUPW class depends on the school authorities. "We literally have to beg them to consider our programme," says Lalita Ramdas of Ankur.

The World Wildlife Fund's (WWF) Nature Club Programme has some 15,000 members across India. These members receive newsletters and features on a regular basis. The Society for Environmental Education, Kerala (SEEK) assists over 60 WWF–registered nature clubs. The World Wildlife Fund–India has also used the SUPW classes in Delhi to focus on wildlife conservation. The WWF has requested Delhi's directorate of education to introduce environmental education on a formal basis in schools. But even after formalisation of environmental education, Sharad Gaur of WWF strongly feels that it should continue to be managed by non–governmental organisations like Ankur and the WWF.

The Society for Clean Environmental (SOCLEEN) in Bombay also has a programme for some 350 Marathi medium schools involving lectures, field visits and working projects. Every year SOCLEEN chooses a special topic like noise pollution. Kalpavriksha in Delhi is a unique organisation of school and college-going students. The group closely follows environmental developments in Delhi and has publicly agitated against several decisions that could adversely affect the environment of the capital. Kalpvriksha members take time off whenever possible to teach other schoolchildren and to organise workshops on environment. With the graduation of several Kalpvriksha members out of school to college, several colleges have started independent nature clubs, notably the Hindu College Nature Club. In 1983, the Hindu College Nature Club and Kalpvriksha organised a study tour along the Narmada Valley (see Dams chapter), which is in the process of being irreversibly transformed by a series of hydroelectric dams. The group's report has helped to focus nationwide attention on the problem.

popular participation.

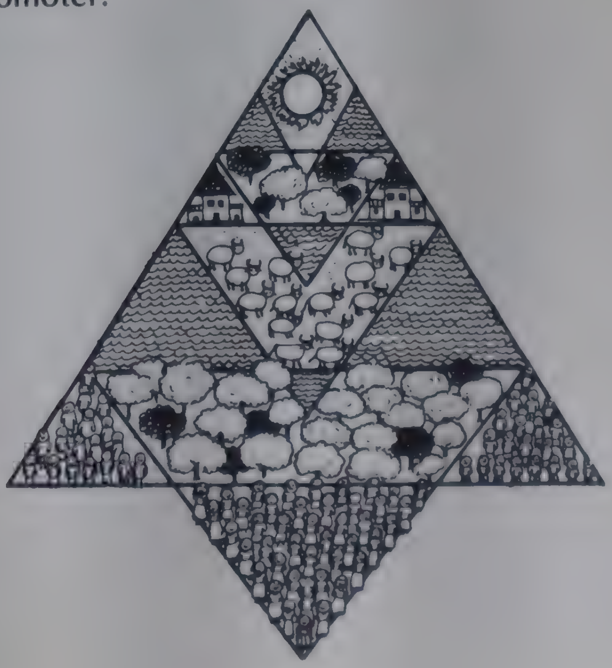
Interest in environment now cuts across the entire range of relief and charity groups to development and action groups. Ecodevelopment is of interest to many action and development groups because almost all such grassroots groups are in their own ways searching for an alternative to the present model of development.

## Constraints

Voluntary environmental groups work with a series of constraints, most of which they share with the voluntary sector as a whole. Firstly, there is a lack of trained personpower to carry out in-depth technical and economic analysis, though as far as social and political analyses are concerned voluntary groups are often better than even most academic and highly specialised institutions. Certain individuals from support voluntary groups, universities and certain scientific and other specialised institutions do help the voluntary sector occasionally. But it is still very difficult for a voluntary group opposing a dam in a remote area to find an expert who can carry out an independent environmental impact analysis of the dam which would give their campaign a sharper edge.

Lack of access to authentic data from official sources on projects and programmes with environmental implications is a second important constraint and, once again, the gap is bridged to some extent by smaller voluntary groups seeking the support of voluntary groups respected within government circles or of sympathetic government officials and journalists. A third constraint is the lack of statutory support and judicial sympathy for efforts of non-official groups willing to fight against agents of environmental destruction. Judicial interest in environmental issues is definitely growing and is providing an avenue for environmental firefighting. But, definitely, there is still a long way to go before this interest percolates down to the lower courts.

By trying to work together more and more, especially on specific issues, when networks tend to get formed more easily, the voluntary groups have ocassionally been able to get over their smallness and have succeeded in getting their voice heard. The successful campaign against the Forest Bill is a good example of such coming together. Current efforts to get groups working with slum dwellers is another example. In sum, it can be said that the environmental issue is now definitely on the agenda of the voluntary sector and if it continues to grow at the same pace, despite all the existing constraints, it cannot but become a key issue on the national political and developmental agenda. If that happens, the voluntary sector will definitely have been the lead promoter.



# LEGISLATION

There are more than 200 Central and state laws today that can be interpreted one way or another to protect the environment. The earliest of them, the Shore Nuisance (Bombay and Kolaba) Act, dates back to 1853. But laws enacted with the specific intention of controlling environmental degradation have been slow coming, partly because of inadequate appreciation of environmental problems and partly because of wrong notions about legislative competence.

Until 1976, environment protection as such did not figure anywhere in the Constitution. In the Seventh Schedule, which classifies various legislative entries into three groups, the Union List, the State List, and the Concurrent List, there are various entries like forests and wildlife related to environment. On the face of it, it seemed that state legislatures alone are empowered to legislate on some of the most vital matters affecting environment.

When the Constitution was amended for the 42nd time in 1976, certain environmental provisions were incorporated. For the first time the expression "environmental protection" found a place and this led many scholars to argue that by the 42nd Amendment, the Central government wanted certain powers which it did not have to protect the environment. But this may not be true.

Article 48 A was added to the Directive Principles of State Policy and stated:

"The State shall endeavour to protect and improve the natural environment and safeguard the forests and wildlife in the country." In the Chapter on Fundamental Duties, which itself was inserted into the Constitution for the first time, Article 51 A(g) provided: "It shall be the duty of every citizen of India to protect and improve the natural environment including forests, lakes, rivers and wildlife and to have compassion for living creatures." Besides this, the entries dealing with "forests" and "wildlife" were dropped from the State List and inserted in the Concurrent List.

It is not clear from the 42nd Amendment that the intention of the Union government was to have additional powers. For instance, the provision incorporated in the Chapter on Fundamental Duties does not make such sense. There is no machinery to enforce this duty. Moreover, this "duty" provision is much more sweeping and all-encompassing than the one incorporated in the Directive Principles of State Policy. What additional powers this article gives is hard to understand, other than an expression of the

### Powerful Knowledge

Knowledge is today a major source of power and control. A whole profession of knowledge producers and distributors has emerged in the last fifty years, and increasingly, knowledge has become a commodity, with its own market mechanism. Producers of knowledge are called researchers and social science has become a full–fledged enterprise.

Researchers claim objectivity and neutrality. But under the guise of objectivity and neutrality, research often ends up supporting, advertently as well as inadvertently, the perpetuation of current inequalities and deprivations.

Researchers have also taken upon themselves the task to define what is knowledge. They invariably exclude people's own popular knowledge from the purview of scientific and valid knowledge. This makes ordinary people dependent on experts to tell them what is good for them. Taking away from them their capacity to produce their own knowledge, is a mechanism by which power is maintained and control over them assured.

Participatory research on the other hand, asks: whose interests does research objectively serve ? Who is involved in the process of research and in defining the very focus of research ? Participatory research legitimises popular knowledge and gives people power of the knowledge.

Several efforts are being made in India to promote participatory research. During the past two years, studies on the extent and causes of deforestation have been undertaken in Himachal Pradesh and Orissa. Forest dwellers have been able to determine the causes and extent of deforestation through their songs, plays, physical verification, stories and discussions. This has generated an alternative data base. Forest departments are also collecting and analysing deforestation data from the point of view of foresters and they invariably conclude that forest dwellers are the main destroyers of forests. Peoples' perception and analysis show the opposite, that commercial and industrial interests are the main causes of deforestation. As a result of their studies, the forest dwellers of Phulbani and Ganjam districts of Orissa have started questioning governmental officials about future forest development plans. In Chamba and Chopal, Himachal Pradesh, forest dwellers have started demanding drinking water and fuelwood plantations nearer their villages.

In Maharashtra, Orissa and Rajasthan, tribals are beginning to collect information on the processes and extent of land alienation. Their analysis shows that development schemes have often caused land alienation and further marginalisation. Bonded tribals of Thane district have organised themselves into the Shram Jivi Sangathana and are now investigating the extent of land alienation that has taken place. In Chittorgarh, Rajasthan, tribals displaced by an irrigation dam are investigating their problem and demanding better compensation. In the Ganjam district of Orissa, a group of tribals has analysed the land alienation potential posed by an impending dam, and has approached officials to stop the dam.

In textile mills of Kanpur and chemical and engineering factories of Bombay and Madurai, several industrial workers have begun to investigate the problem of occupational health hazards. About one thousand textile workers of Kanpur are using drama and discussions to educate themselves about the problem of byssinosis. They have also decided to put occupational health on their charter of demands. The engineering workers of a Bombay factory are holding regular meetings among themselves to analyse the problem of noise and have initiated preliminary discussions with the factory's management to do something about high noise levels.

These examples demonstrate how people are capable of getting involved in their own research. They have also started asking outside researchers to spell out what is in your research for us.

Struggles and movements of the poor and marginalised fail to attract the support of researchers and professionals. For instance, the slum dwellers' efforts to resist the anti-encroachment acts of Bombay and Delhi have not been able to attract many social scientists, urban planners or architects. The training and professionalisation of researchers makes them afraid taking political stands favouring the poor.

In many instances, social scientists have even taken clear positions in favour of the status quo. In several instances of air and water pollution, government experts and researchers have exonerated the factory managers. In a recent case of nitric oxide poisoning of workers at the Rashtriya Chemicals and Fertilizers Co in Bombay, the doctors appointed by the management to examine the workers have pronounced all workers healthy. The management is now using their report against the workers. When workers' protests about water and air pollution from the Gwalior Rayon plant at Nagda started in 1978, the experts of the Pollution Control Board of Madhya Pradesh wrote long articles in the press denying any pollution and justifying the action of the management. Participatory research has the potential to demystify research and democratise knowledge.

government's willingness to legislate on these issues. Also, by bringing the entries of "forests" and "wildlife" from the State List to the Concurrent List, the Centre was not taking away the state's right to make laws. It only meant that from then on the Union government could also pass laws covering these two areas.

Does not the Union government have these powers otherwise? The much forgotten Article 253 says: "Notwithstanding anything in the foregoing provisions of this Chapter, Parliament has powers to make any law for the whole or any part of the territory of India for implementing any Treaty, Agreement or Convention with any other country or countries or *any decision made at any international conference, association or other body* (emphasis added)." Thus, Parliament has always had unlimited power to pass any law, covering the State List entries even without the 42nd Amendment. And indeed the latest environmental act — the Air Act, 1981 — has been enacted on the basis of this provision.

The enacting of the Wildlife (Protection) Act, 1972 and the Water (Prevention and Control of Pollution) Act, 1974, has been acclaimed as ushering in a new environmental era. To these can be added two more: the Forest Conservation Act, 1980 and the Air (Prevention and Control of Pollution) Act, 1981. These legislations had environmental conservation clearly in mind, whereas the legislation brought into force prior to 1972 always had some other objective. Environmental conservation was only incidental to them. The Wildlife Act, 1972, and the Water Act, 1974, were passed by the Central government after following the procedure provided in Article 252 (two or more states adopting the enabling resolutions empowering the Parliament to pass a law on the subject). The Air Act, 1981, was to give effect to the decisions taken at the UN Conference on Human Environment held in Stockholm in 1972.

## Wildlife Act

The Wildlife (Protection) Act, 1972, provides for the constitution of a Wildlife Advisory Board, regulation of hunting of wild animals and birds, laying down of procedures for declaring areas as sanctuaries and national parks, and regulation of trade in wild animals.

Its successful implementation is to the credit of the Indian Board of Wildlife. The board, consisting of official as well as non-official members, is only an advisory body. But as the Prime Minister is the chairperson, its advice is generally heeded.

On the lines of the Indian Board of Wildlife, state wildlife advisory boards have also been constituted. Treating wildlife and forests as a unified subject and their joint management within the state departments of forest has been hotly debated. Some experts felt that the departments of forest should be split into two, with new departments of wildlife to take care of national parks and sanctuaries.

The Union government is now planning new legislation to declare and protect biosphere reserves in the country. Going by the bill under consideration, the administrative set-up to be provided in the Indian Biosphere Reserve Act is likely to be the same as that in the Wildlife (Protection) Bill is

## Water Act

As early as 1962, the Ministry of Health had appointed an expert committee on water pollution. The committee recommended that Central as well as state laws on the subject be enacted. The Central Council of Local Self-Government recommended in 1963 the enactment of a single law by Parliament. A draft bill was circulated to all state governments in 1965 with the request to pass enabling resolutions authorising Parliament to enact the above law on their behalf as required in Article 252 (1). The Prevention of Water Pollution Bill, 1969 was introduced in the Rajya Sabha after six states had adopted enabling resolutions. In August 1970, the Rajya Sabha decided to refer the bill to a joint committee, which modified it in many respects and then presented it to Parliament in 1972. Parliament passed the bill in 1974.

The Water Act is sweeping. Pollution, sewage effluent and trade effluents are fairly comprehensively defined. The act makes provision for the composition of Central and state boards. These boards are autonomous and they can sue and be sued. A provision has been made to represent the interests of agriculture, fishery, industry or trade and also of the companies or corporations owned, controlled or managed by the Central and state governments.

Besides advising the Central government on matters concerning prevention and control of water pollution, the Central board also acts as the state board for all the union territories. While exercising its powers, the Central board is bound by the directives of the Central government whereas the state board is bound by the directives of both the Central and the state boards. Where a directive of the state government is inconsistent with one of the Central board, the matter is to be referred to the Central government.

There are several enforcement problems. Though the act expressly confers powers and functions on the water boards, it is silent on funds, which it leaves to state governments. As long as funds are uncertain, state boards cannot enforce the act effectively. Keeping this in mind the government considered a proposal to impose a cess to meet the expenses of the Central and state boards for the prevention and control of water pollution. The Water (Prevention and Control of Pollution) Cess Act was passed in 1977 to help augment resources, and control of water pollution.

This act attracted a lot of litigation from industries. Subtle distinctions were drawn and attempts made to be out of the act's ambit. Since the main idea was to augment the meagre resources of the boards, a wiser course of action would have been to cover all industrial activities and to collect cess. By not doing so an erroneous impression was given that the cess was being collected from the polluting industry as a fine, which was not the intention of the legislature.

The other important provisions that merit special attention in the Water Act, 1974 include Section 24 (1) dealing with the prohibition on the use of streams or wells for the disposal of polluting matter. Under section 24 (1), it is an offence to knowingly cause or permit to enter into any matter which may tend, either directly or in combination with similar matter, to impede the proper flow of water of the stream in a manner leading or likely to lead to a substantial aggravation of pollution due to other causes or

### Selective list of environment related legislation

CENTRAL ENACTMENTS

1. **Water Pollution**
   - 1.1 The River Boards Act, 1956.
   - 1.2 The Merchant Shipping (Amendment) Act, 1970
   - 1.3 The Water (Prevention and Control of Pollution) Act, 1974
   - 1.4 The Water (Prevention and Control of Pollution) Cess Act, 1977.
2. **Air Pollution**
   - 2.1 The Indian Boiler's Act, 1923.
   - 2.2 The Factories Act, 1948
   - 2.3 The Industries (Development and Regulation) Act, 1951
   - 2.4 The Mines and Minerals (Regulation and Development) Act, 1947
   - 2.5 The Air (Prevention and Control of Pollution) Act, 1981
3. **Radiation**
   - 3.1 The Atomic Energy Act, 1962
   - 3.2 Radiation Protection Rules, 1971
4. **Pesticides**
   - 4.1 The Insecticides Act, 1968
   - 4.2 The Factories Act, 1948
   - 4.3 The Poison Act, 1919
5. **Others**
   - 5.1 The Wild Life (Protection) Act, 1972
   - 5.2 The Indian Forest Act, 1927
   - 5.3 The Indian Fisheries Act, 1897
   - 5.4 The Urban Land (Ceiling & Regulation) Act, 1976
   - 5.5 The Prevention of Food Adulteration Act, 1954
   - 5.6 The Ancient Monuments and Archaelogical Sites and Remains Act, 1958
   - 5.7 The Forest Conservation Act, 1980

STATE ENACTMENTS

1. **Water Pollution**
   - 1.1 Orissa River Pollution Prevention Act, 1953
   - 1.2 Maharashtra Prevention of Water Pollution Act, 1969
2. **Smoke Control**
   - 2.1 The Bengal Smoke Nuisance Act, 1905
   - 2.2 The Gujarat Smoke Nuisance Act, 1963
   - 2.3 The Bombay Smoke Nuisance Act, 1912
3. **Pest Control**
   - 3.1 The Andhra Pradesh Agricultural Pest and Disease Act, 1919
   - 3.2 The Assam Agricultural Pests and Disease Act, 1954
   - 3.3 The UP Agricultural Disease and Pests Act, 1954
   - 3.4 The Mysore Destructive Insects and Pests Act, 1917
   - 3.5 The Kerala Agricultural Pests and Disease Act, 1958
4. **Land Utilisation and Land Improvement**
   - 4.1 The Andhra Pradesh Improvement Scheme Act, 1949
   - 4.2 The Acquisition of Land for Flood Control and Prevention of Erosion Act, 1955.
   - 4.3 The Bihar Waste Lands (Reclamation, Cultivation and Improvement) Act, 1946
   - 4.4 The Delhi Restriction of Uses of Land Act, 1964

of its consequences by any persons. The expression "knowingly" qualifies the words "cause" or "permit" thereby making it obligatory for the prosecution to prove in either case the existence of knowledge on the part of the polluter before the polluter can be held responsible. The situation where a person permits polluting matter into any stream by negligence is not covered.

The water board has no authority to directly deal with the erring industries and is required to approach the judiciary for issuing directions. Even when found guilty, a management can be punished with imprisonment and fine, but there is no provision to enable a court to direct any industries to close down. The court's procedures are time consuming and the inherent delays prevent quick and corrective action.

**Forced closure**

In some cases, forced closure may be necessary to make the polluter act and take preventive steps. In the case of Zuari Agro Chemicals Limited in Goa, the industry was persistently requested to treat the effluent water. As the requests fell on deaf ears, the government had to invoke the Public Nuisance Act and the industry was closed down for two and a half years by the district magistrate. Within two months the industry undertook certain measures to treat the

### The Right To Know

Unlike most Third World societies, India has a reasonably open society. But it is also true that a great deal of information is withheld from the people. Perhaps the classic case is that of the Forest Bill. When the details of the first draft policy leaked out, it became apparent that under the guise of protecting forest wealth, the government was in fact planning to acquire excessive powers to deal with the poor who normally rely on forests for their daily needs. Were it not for the public debate initiated by voluntary groups throughout the country, the bill—circulated only to MPs, which can hardly be deemed sufficient public exposure—would have probably gone through Parliament without a whimper. The national Forest Policy document and the revised bill prepared by the government after these public protests, have also been withheld from the public—and these documents affect the lives of some 500 million people.

Another example: environmental impact assessment of large development projects. The most recent case concerns the Bhopalpatnam and Inchampalli hydel and irrigation projects which will inundate around 40,000 hectares and displace 75,000 people; no one living in the area seems to know which areas will be submerged when the rivers are dammed. People displaced by huge projects like Sardar Sarovar on the Madhya Pradesh-Gujarat border and Koel Karo in Bihar are never told sufficiently in advance where they will be shifted to, what compensation they will receive and how they will be able to earn a livelihood.

Among the most deprived are tribals who have to move from forests to make way for wildlife sanctuaries. When the notification for the Indravati National Park in Bastar district was issued a couple of years ago, park officials tried to coax reluctant villagers to shift to new resettlement sites as quickly as possible. "If you don't make up your minds fast," they were warned, "someone else will grab the best sites."

To begin with, detailed project reports—DPRs, as they are known to engineers—are treated as confidential documents. A familiar technique is to pass on the original document, which does not contain much information, whereas it is the revised reports that really count. In the case of Silent Valley the first DPRs, reveal that there was no concern originally about the destruction of natural resources, but later documents began to refer to safeguards and afforestation. To settle the protracted controversy over the fate of Silent Valley, a committee headed by Professor M.G.K. Menon was appointed to finally arbitrate the dispute. Its report was submitted to the Centre in the middle of 1983 but till today, for reasons best known to itself, the DoEn has refused to make it public.

Politicians take advantage of this all-consuming secrecy. In the case of the Thal-Vaishet gas-based fertiliser plant, 20 km from Bombay on the mainland, local residents, backed by Bombay environmentalists, protested against the site. The effluent water and the factory was allowed to resume operations.

Section 32 of the Water Act empowers the board to take some emergency measures. But that is only where it appears to the state board that any poisonous, noxious or polluting matter is present in any stream or well due to any accident or other unforeseen act or event. There is no provision in the entire Water Act shifting the burden of proof from the prosecution to the polluter, a provision generally found in acts like the Industries (Development and Regulation) Act, 1951.

Finally, section 49 (1) provides that "no court shall take cognizance of any offence under this Act except on a complaint made by, or with the previous sanction in writing of the State Board . . . ." Had the right been given to the individual along with the Water Board, as was done in the Orissa River Pollution Act, 1954, one of the first Water Pollution Control Acts in the country, the implementation of the water act would have been much more effective. These are some of the anomalies in the act which, when rectified, would further enhance its efficacy.

From the practical experience gained in the implementation of the water act, an effort was made by way of an amendment act passed in 1978 to strengthen the hands of the boards in implementation. The amendment act contains 22 sections but fails to bring about any major changes that are likely to provide for effective implementation.

This sad state of affairs led the Central board to constitute an amendment committee with representatives taken from various state boards. The state boards came up with detailed proposals. The total amendments recommended to both the Water Act, 1974 as amended in 1978, and the Water Cess Act, 1977 are 58. The major amendments proposed to the Water Act include empowering the board to call for any information as it

National Committee on Environmental Planning and Coordination (NCEPC) appointed a task force under Dr A.K. Ganguly of the Bhabha Atomic Research Centre (BARC) to examine the environmental impact at alternative sites. He twice ruled out the original location as well as Thal-Vaishet, but because these reports weren't made available, Sharad Pawar, then Maharashtra chief minster, claimed on the floor of the house that the task force had given Thal-Vaishet the green signal. The Assembly voted unanimously in favour of this site—against the specific advice of experts who included a representative of Rashtriya Chemicals and Fertilisers, which was putting up the plant. Today, barely months away from the completion of the project, it is not easy to obtain copies of the two reports of the Ganguly committee.

In yet another fierce environmental controversy, over the Mathura Oil Refinery's impact on the Taj Mahal, though over Rs 20 lakh was spent on the studies conducted by the Italian firm Tecneco alone, there are just a handful of these volumes around. Even officials in the Archaeological Survey of India haven't had free access to them and a official in the chemistry section actually had to read the reports in Rome where he had gone on official work. The calculations of the likely "fall-out" from the refinery to a destination 40 km away done by the Indian Meteorological Department are not available to the public: the last few are included in the report of the Varadarajan committee but the earlier studies are simply not available.

Urban environmental issues are similarly made more complicated by the absence of details. Recently, for example, Dr T.N. Khoshoo, secretary of the DOEn flew down to Bombay to discuss with the Bombay Environmental Group, SOCLEEN and other organisations, their reasons for opposing the road bridge proposed by the J.R.D. Tata Committee between Bombay and the mainland. He was surprised to find that the groups weren't even aware of the choice of three alternative links, let alone the actual alignment of the bridge, and instructed the secretary of the Maharashtra Public Works Department to take members of these bodies to the actual site. For that matter, the reports of the foreign and Indian consultants retained at considerable expense to advise on the bridge are not available to the public.

An even more shocking case, of course, was the cavalier manner in which Bombay's draft development plan for 1981-2001 was almost surreptitiously released for public comment in 1984. Although the municipal corporation allowed 60 days for objections, hardly anyone was aware that the report was out. When an earlier draft was similarly released, the Save Bombay Committee went to court and obtained a considerable extension of time for submissions from citizens.

Nowhere is the secrecy more blatant than in nuclear energy. The occasional exposes of the lack of safety precautions at the Tarapur Atomic Power Station, for example, are dismissed by BARC officials as either totally wrong or motivated by "anti-national" elements. Even the documents that the Indian nuclear establishment readily provides to the International Atomic Energy Agency (IAEA) and other organisations of the West, are not easily available to the Indian public. The only library where IAEA material is available—the DAE's in Bombay—is closed to outsiders.

The reluctance to part with information can reach ridiculous limits: when it comes to occupational health, for instance, managements of factories refuse to disclose the results of medical tests to the workers themselves; they are even more circumspect about revealing symptoms of chronic ailments. Agencies like the National Institute of Occupational Health (NIOH) and the Central Labour Institute do not divulge the names of the companies they are surveying, and won't part with copies of studies initially on the ground that these are the "property of the client". A couple of years ago, the National Environmental Engineering Research Institute (NEERI) was adamant about not parting with data relating to a study it had conducted of the Tarapur industrial estate for Mahindras, which wanted to put up a vehicle factory there. The atmosphere was so contaminated with acid that engineering units were hit by corrosion, which naturally deterred the firm from investing there. At one stage, environmentalists were even advised that Mahindras might be persuaded to ask NEERI to release the data.

V.K. Krishna Iyer, former justice of the Supreme Court, has recently argued in 'Mainstream', "the right to express one's thought is meaningless if it is not accompanied by a related right to secure all information on matters of public concern from relevant public authorities." He adds, "A citizen can usefully exercise his right to criticise, comment or approve policies or even form an intelligent opinion on them, as is expected of him in a participatory democracy, only if there is freedom of information as ancillary to the freedom of expression." Krishna Iyer argues that the Supreme Court "has struck a blow against secrecy in administration and for open government (in the Judges Case). The State shall not withhold from the litigant and the court any public information needed for public justice save exceptional materials dangerous in the public interest to disclose. But even without litigation being necessary, every Indian must be armed with the right to demand all such information as concerns public interest."

The spate of public interest litigation concerning the Ratlam municipality, Asiad construction site workers and Mussoorie quarrying indicates that it will not be long before pressure steadily mounts on the state to divulge information on environmental issues. As a test case, social workers involved with Baba Amte in the campaign against the Bhopalpatnam-Inchampalli dams are planning to seek information about all development projects in their district from the district administration. If the information is refused, they intend to go to court.

### Public interest litigation

Moving the courts in the interest of the people has rapidly become a crucial part of activism in India. Among the environmental cases in this field that have been either decided or are pending judgement is a writ petition filed by a Delhi based journalist for a mandamus directing amongst others the Central Water Pollution Control Board to implement the provisions of the Water Act. A writ petition that has been decided upon by the Supreme Court relates to the upkeep of the clean environment of the Doon Valley by banning mining activities. The Supreme Court has admitted a writ peition filed by former MP Kanwarlal Gupta alleging non-implemention of pollution measures in the power houses and industries in Delhi resulting in a large number of TB cases.

In the Delhi High Court, there is a petition filed by Manoj Sharma, a resident of Delhi, seeking directions against public authorities to stop polluting the river Yamuna by discharging raw and untreated sewage into it. At every hearing, Sharma faces a battery of lawyers representing the government and other agencies while he himself has not engaged any lawyer. But the court has given him a sympathetic hearing and in mid-December 1984 the court passed strictures on the Municipal Corporation of Delhi and concerned public authorities for the "utter apathy" shown towards this litigation.

Several petitions relating to occupational health problems have also been filed in the Supreme Court, including the petition to direct the state of Madhya Pradesh to take steps to reduce dust in the work environment of slate pencil factories in Mandsaur. Another petition filed by a trade union has sought directions to the state government to take action under the Mines Act to protect the health of workers working in the Roro Asbestos Mines in Singhbhum, Bihar. A petition has even been filed by a professional big-game hunter against the guidelines of the Indian Board of Wildlife that humaneating tigers should not be shot as far as possible, arguing that this endangers the life of people.

In some cases the Supreme Court has issued interim orders providing relief. It has asked the Bihar Government not to take possession of land from any of the tribals who are in natural occupation in the Koel Karo project area in Ranchi: the construction of a dam across two rivers in south Bihar. In cases where there was lack of evidence, the Supreme Court appointed experts commissions. In one case, the Supreme Court appointed a commissioner to look into various allegations of false criminal and forest cases which are being filed against the tribals of Singhbhum district. The report revealed how the administration of justice has been abused in the district to oppress the poor and create a state of near-terror'!

It was reported that in the court of the chief judicial magistrate, there were thousands of cases pending without even a chargesheet filed. Some of them were filed as early as 1979. About 600 tribal belonging to this district alone are kept in detention. The annual returns sent from the district to the high court showed an average of 3,607 arrests and 6,450 warrants a year. Criminal cases for the area come to 21,462 per year — tribals constitute 60 per cent to 80 per cent of the total population. Besides the criminal cases, an average of 1,742 cases are filed every year in the courts of the executive magistrates under the head 'miscellaneous cases' affecting about 5,150 persons. Only 5 per cent ended up with convictions. Out of forest cases, only 702 ended in conviction and usually forest cases are almost always against tribals.

The commissioner was shocked to find that a good number of cases had FIRs in the name of a few tribals with the rider "and others", a convenient loophole for the police to implicate anyone as and when they wanted to. Tribals pointed out to the commissioner that some tribals appeared in more than one case occurring at different places on the same day. Warrants of arrest had been issued in the name of persons dead and gone. One tribal commented: "This is because the names of the accused are filed in from the voters list."

Public interest litigation has in no way been an unqualified success. In the case of Mandsaur slate pencil industry workers, the Supreme Court directed the state government to demand of the factory owners that they install high efficiency dust control devices, otherwise their licenses could be cancelled. But hardly any factory has complied and the petitioners are contemplating filing for contempt of court.

Filing cases also needs proof of existence. Unnayan, a Calcutta agency, which tried to get slum dwellers enumerated in voters lists, was frustrated by the requirements of legal documents. For the slum dwellers, few of whom had even ration cards, providing a clear address, and proof of residence was difficult. The authorities were suspicious of the agency and refused to believe that such a large number of voters could have been missed by the enumerators. Though a list of names was finally accepted, four months later the matter was still under review.

The court has itself found its powers limited in many cases. In Bombay pavement dwellers case, Chief Justive Y.V. Chandrachud, on the request of the petitioners' counsel, directed the Bombay Municipal Corporation (BMC) and the Government of Maharashtra to work out and submit a list of sites of vacant land in the city which could be used to house the poor. This list was to be produced in two weeks. When the court resumed hearing, the counsel for the BMC, despite being asked by the judges, refused to supply the list; he simply said, "Lordships, this is a policy decision."

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deems fit; incorporation of the strict liability principle; empowering the board to take certain measures to prevent apprehended pollution without having to invoke the jurisdiction of the court; empowering the board to enhance the penalty; special courts for expeditious disposal of cases.

These recommendations once accepted and brought forward as amendments to the act would go a long way towards strengthening the implementation process by the state boards. However, if one goes by the normal time taken by the Central government to accept these proposals and prepare a draft for circulation amongst the state governments in order to get the constitutionally required enabling resolutions to amend the act, a lot of damage to the environment would go unchecked. An alternative and probably faster approach could be for state boards to persuade their state governments to prepare a draft amendment and request the Central government to bring out a suitable amendment. The Central government is likely to be more attentive when a state legislature makes a request.

## Air Act

Even though no attempt was made till recently to enact comprehensive legislation for prevention and control of air pollution, India has had laws on air pollution for the last 79 years. The Bengal Smoke Nuisance Act came into being as early as in 1905 and Bombay and Kanpur followed suit in 1912 and 1958. Many other state legislatures extended the application of the Bengal Smoke Nuisance Act to their states also. These acts are mainly concerned with smoke coming out of industries. But still numerous new industries which came into being were not touched by them at all.

The laws dealing with automobile emissions also provide a similar picture. The Motor Vehicles Act, 1939 confers legal powers on state governments to make rules regarding "emission of smoke, visible vapour, sparks, ashes, grit or oil". This provision did not help improve the situation because of the absence of criteria and standards in regard to exhaust fumes and noxious gas, monitoring and surveillance and an enforcement agency.

## Industry Folly

Just how conscientious is Indian industry about pollution control? Speaking at the Indian Institute of Technology in Madras, Dr T.N. Khoshoo, secretary to the Department of Environment commented that whenever there was a power cut, factories first shut down their effluent treatment plants. A spokesperson of the Federation of Indian Chambers of Commerce and Industry (FICCI) admits that industrial houses still hold an "archaic view" about pollution control. Pollution control, as far as they are concerned, is a waste of money. Publicly, of course, a lot of noise is made. FICCI has announced an annual award to industries with good records in pollution control, but this is apparently little more than a public relations exercise.

The government is trying its best to provide financial incentives. A depreciation of 30 per cent is allowed on devices and systems for minimising environmental pollution. An investment allowance at the rate of 35 per cent has been allowed for any new machinery or plant being used to assist in the control of pollution or protection of environment. The state financial institutions have included the installation of effluent treatment facilities under the soft loan scheme, under which loans up to Rs 4 crore carry a 11.5 per cent rate of interest against the normal lending rate of 14 per cent. These institutions also give high priority to financing projects to manufacture waste recycling and effluent treatment plants.

But industry is not impressed. Leading industrialist L.M. Thapar, chairperson of FICCI's sub-committee on environment, told a FICCI seminar held in early 1984 in the presence of the, then industry minister N.D. Tiwari: "The allowances being given by the government are welcome. But are the finances of the corporate sector or even Government companies such that these expenditures can be absorbed? We should not forget that most industries are presently ridden by recession. Take the Reserve Bank's sample of 1,750 medium and large public limited companies. Of them, over 350 are presently incurring losses ......I am saying all this not with a view to make a plea for getting concessions but to emphasise the practical difficulties involved .....The environmentalist who is highly motivated and idealistic is apt to look at the problem from a certain point of view. It has, however, to be borne in mind that we have to work within a given social framework." FICCI also believes that an all-out programme for pollution control, which it estimates will demand an annual additional investment equivalent to 0.5 per cent to 1 per cent of GNP—between Rs 750 crore and Rs 1,500 crore a year—could lead to inflationary tendencies.

The Department of Environment is not convinced. Industry-specific minimal national standards (MINAS) are being prepared by the Central Board for the Prevention and Control of Water Pollution (CBPCWP). The studies conducted so far show that the annual burden of pollution control, which includes capital and operation costs, maintenance and repair, exceeds one per cent of annual turnover to control liquid effluents to the desired level of standards in only a few cases. Fertiliser and textile industries require 2 per cent of annual turnover as annual burden. Industries producing pesticides, pharmaceuticals and dye and dye intermediates cross 3 per cent. Molasses-based alcohol distilleries, which have an extremely high pollutant load, need the maximum. Even with 5 per cent of annual turnover, the pollution control system brings the effluent quality only to the first desired level. "It is generally agreed that the pollution from most of the industries may be contained to the desired level if 3 per cent of annual turnover is put down towards water pollution control," says Dr Khoshoo. Dr Nilay Chaudhuri of the CBPCWP adds that industries can pass this cost on to the consumer.

It is urgent to control pollution from industrial sources: more than three-fourths of industrial production is generated from within 12 cities. While Assam in the Northeast and Himachal Pradesh in the northwest have to control not more than 20 polluting industries each, Maharashtra and Gujarat are required to control no less than 400 to 600 industrial units each.

A survey of polluting industries was conducted by CBPCWP in various states, except Maharashtra, Tamil Nadu, Orissa and five Northeastern states. There are about 2,700 large and medium industries and out of these 1,700 are serious water polluters. Out of the 1,700 surveyed, some 353 have commissioned industrial wastewater treatment plants, 174 have plants under construction and 190 are planning them. Thus, only 717 units have treatment facilities. At this pace, it could take two decades before pollution from large and medium industries is controlled. The total number of polluting industries in India will be between 2,500 and 3,000. This has however proved to be a gross underestimate. In March '85 the Minister of State for Environment, Mr Bir Sain, told the Rajya Sabha that there were about 4,000 polluting industries in the country, only about 200 had installed effluent treatment facilities. And altogether 37 industries in various states have been directed to close down for violation of anti-pollution laws.

Meanwhile, there are few attempts to control pollution from the small-scale sector. While 70 per cent of the volume of industrial wastes is contributed by large and medium industries, 30 per cent comes from small and cottage sector units, on which there are few controls.

But it should still be easy to rapidly reduce pollution from industrial sources. Only a few industries generate most of the pollution. In Hyderabad, for instance, 13 out of 133 units generate more than 90 per cent of industrial wastewater. In Delhi, control of 16 units would cover more than 95 per cent of industrial wastes. A good 'pick and kick' policy could yield effective results, and quickly.

Unfortunately, the government has been lax in implementing its own rules and regulations. The Central government has issued an executive order under which the Central Industrial Licensing Committee is to allow the conversion of the letter of intent into an industrial license if the entrepreneur obtains a no objection certificate from the state pollution control board. But, according to Chaudhuri, "majority of the states are not practising this procedure," nor does the licensing committee check the fulfilment of the no objection certificate requirement with state pollution control boards. Even in those states where these certificates are given, six-monthly progress reports are filed by the industrial units with the Directorate General of Technical Development and not the state pollution control board.

Chaudhuri fears that unless these administrative procedures are seriously enforced, new industries will add to existing pollution. There is a strong belief that states disregard pollution control especially in the case of industries being set up in so-called backward areas—usually the areas with the poorest people, often tribals—with the argument that these industries create employment. This also means that private industry is able to get away with much less pollution control than public sector units. State governments are also afraid that if they implement pollution control laws too harshly, industries could start moving to states which do not.

Prosecutions under the law have also been very few. The Water (Prevention and Control of Pollution) Act was passed in 1974 but the first prosecution took place in Rajasthan in August 1983, when a manager of a paper mill was sentenced to two years' imprisonment and a fine of Rs 2,000. The proprietors of the mill were left untouched.

The Government of India appointed an expert committee on air pollution in 1970 to suggest suitable means for control and to draft an air pollution control bill. This committee prepared a draft bill in which "the best possible means of control", in contrast to the "air quality criteria" approach was recommended. The framework of the Air Act almost follows the one set by the Water Act. With that framework, the anomalies also continue. However, there are certain provisions which deserve attention. Section 20 of the act empowers the state government to give instructions to the concerned authorities in charge of registration of motor vehicles under the Motor Vehicles Act, 1939, for ensuring standards for emission from automobiles. Section 52 lays down that, save as otherwise provided under the

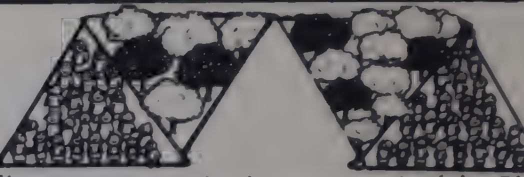
### The Doon Order

In its first major judgement involving a conflict between environmental conservation and industrialisation, the Supreme Court took the side of environment and ordered several mines in the Doon Valley (see box Doon Doon, p. 22) to be closed down. The following is an edited version of the Supreme Court judgement handed down on March 12, 1985:

"This case has been argued at great length before us not only because a large number of lessees of limestone quarries are involved and each of them has painstakingly and exhaustively canvassed . . . factual as well as legal points of view but also because this is the first case of its kind in the country involving issues relating to environment and ecological balance and the questions arising for consideration are of grave moment and significance not only to the people residing in the Mussoorie Hill range forming part of the Himalayas but also in their implications to the welfare of the generality of people living in the country. It brings into sharp focus the conflict between development and conservation and serves to emphasise the need for reconciling the two in the larger interest of the country.

"We had by an Order dated 11th August 1983 appointed a Committee consisting of Shri D.N. Bhargav, controller general, Indian Bureau of Mines, Nagpur, (and others) for the purpose of inspecting the limestone quarries. This Committee divided the limestone quarries into three groups. The limestone quarries in category A were those where the adverse impact of the mining operations was relatively less pronounced; category B comprised those quarries where the adverse impact was relatively more pronounced and category C covered those quarries which had been directed to be closed down by the Bhargav Committee under the orders made by us on account of deficiencies regarding safety and hazards of more serious nature.

"It seems that the Government of India also appointed a Working Group on Mining of Limestone Quarries in Dehradun-Mussoorie area, some time in 1983. The Working Group recommended that the limestone quarries should be divided into two categories; category 1 comprising limestone quarries considered suitable for continuance of mining operations and category 2 comprising limestone quarries which were considered unsuitable for further mining.



"The limestone quarries in category A of the Bhargav Committee Report were the same limestone quarries which were classified in category 1 by the Working Group and the limestone quarries in categories B and C of the Bhargav Committee Report were classified in category 2 of the Report of the Working Group. The only difference between the Bhargav Committee and the Working Group was in regard to limestone quarries classified in category B. The Bhargav Committee Report took the view that these limestone quarries need not be closed down, but it did observe that the adverse impact of mining operations in these limestone quarries was more pronounced, while the Working Group definitely took the view that these limestone quarries were not suitable for further mining.

"We shall not examine in detail the question as to whether limestone deposits act as aquifers or not. But there can be no gainsaying that limestone quarrying and excavation of the limestone deposits do seem to effect the perennial water springs. This environmental disturbance has however to be weighed in the balance against the need of limestone quarrying for industrial purposes in the country and we have taken this aspect into account while making this order.

"We are clearly of the view that so far as the limestone quarries classified in category C in the Bhargav Committee Report are concerned, which have already been closed down under the directions of the Bhargav Committee, should not be allowed to be operated. If the lessees of these limestone quarries have obtained any stay order from any court permitting them to continue the mining operations, such stay order will stand dissolved and if there are any subsisting leases in respect of any of these limestone quarries they shall stand terminated without any liability against the State of Uttar Pradesh.

"We would also give the same direction in regard to the limestone quarries in the Sahasradhara Block even though they are placed in category B by the Bhargav Committee. So far as these limestone quarries in Sahasradhara Block are concerned, we agree with the Report made by the Working Group and we direct that these limestone quarries should not be allowed to be

Atomic Energy Act, 1962, in relation to radioactive air pollution, the provisions of this act shall have overriding effect in case of inconsistency with any other enactment.

The government's view is that there should be an integrated approach for tackling the environmental problems, particularly relating to pollution. It is, therefore, proposed that the Central Board for the Prevention and Control of Water Pollution constituted under the Water (Prevention and Control of Pollution) Act, 1974, will also perform the functions of the Central board for the prevention and control of air pollution and of state boards for the prevention and control of air pollution in the union territories. It is also proposed that the state boards constituted under the said act will perform the functions of state boards in respect of prevention, control and abatement of air pollution. As the air act is designed to be extended to the whole of India and as the water act is so far not acceded to by some states, it is proposed to constitute separate state boards for the prevention and control of air pollution.

The characteristic feature with the enactment of the water and air pollution laws is that they took more than 10 years to take final shape. While this in itself is damaging, the time taken to begin implementation under the act is highly depressing. In the case of the air act more than 18 months had to lapse before the rules under which the act could be enforced were accepted by the government. This brings us to the question of political will to enforce the laws without which no amount of legislation can improve the situation.

## Forest (Conservation) Act

This important piece of environmental legislation has received very little public attention, which has focussed more on the proposed Forest Bill, amending the Forest Act, 1927. This act stipulates that no forest land or any portion thereof may be used for non-forest purposes without the permission of the Central government. It provides for the constitution of an advisory committee to advise the government on the cutting of forests.

The mechanics of implementation are seldom made known to the public to assess its success. However, certain useful conclusions can be reached even with the fragmented information available. The 1983-84 annual report of the Department of Agriculture and Cooperation claims that the Government of India restricted the release of forest lands to meet developmental needs and brought down the average annual loss of forest areas from about 0.15 million hectares prevalent before the act came into force, to about 3,600 hectares per annum thereafter.

A look at newspaper reports during the same period, however, does not demonstrate the same level of political will to save the forests. While it is possibly true that a lot of forest felling has been stopped under the act, in several

> operated and should be closed down forthwith. We would also direct, agreeing with the Report made by the Working Group that the limestone quarries placed in category 2 by the Working Group other than those which are placed in categories B and C by the Bhargav Committee should also not be allowed to be operated and should be closed down . . .
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> "So far as the limestone quarries classified as category A in the Bhargav Committee Report and for category 1 in the Working Group Report are concerned, we would divide them into two classes, one class consisting of those limestone quarries which are within the city limis of Mussoorie and the other consisting of those which are outside the city limits. We take the view that the limestone quarries falling within category A of the Bhargav Committee Report and for category 1 of the Working Group Report and falling outside the city limits of Mussoorie, should be allowed to be operated . . . So far as the limestone quarries classified in category A in the Bhargav Committee Report and or category 1 in the Working Group Report and falling within the city limits of Mussoorie are concerned, we would give the same direction which we are giving in regard to the limestone quarries classified as category B in the Bhargav Committee Report.
>
> "That takes us to the limestone quarries classified as category B in the Bhargav Committee Report and category 2 in the Working Group Report. We do not propose to clear these limestone quarries for continuance of mining operations nor to close them down permanently without further inquiry. We accordingly appoint a high powered Committee . . . Lessees of the limestone quarries classified as category B in the Bhargav Committee Report will be at liberty to submit a full and detailed scheme for mining their limestone quarries to this Committee . . . The Committee will proceed to examine the same without any unnecessary delay and submit a report to this Court whether in its opinion the particular limestone quarry can be allowed to be operated in accordance with the scheme and if so, subject to what conditions and if it cannot be allowed to be operated, the reasons for taking that view. The Committee will also insist on a broad plan of exploitation coupled with detailed mining management plans to be submitted along with the scheme or schemes and take care to ensure that the limestone deposits are exploited in a scientific and systematic manner . . . It should also be the concern of the Committee while considering the scheme or schemes submitted to it and making its report, to ensure that the limestone, on exploitation, is specifically utilised only in special industries for which high grade limestone is not required. The Committee will also be entitled to hear the petitioner, the interventionists in this case and such other persons or organisations as may be interested in maintenance and preservation of healthy environment and ecological balance. The Report submitted by the Committee in each case will be considered by the Court and a decision will then be taken whether the limestone quarry or quarries in respect of which the report has been made should be allowed to be operated or not. But until then these limestone quarries will not be allowed to be operated or worked.
>
> "The consequence of this Order made by us would be that the lessees of limestone quarries would be thrown out of business. This would undoubtedly cause hardship to them, but it is a price that has to be paid for protecting and safeguarding the right of the people to live in healthy environment with minimal disturbance of ecological balance and without avoidable hazard to them to their cattle, homes and agricultural land and undue affectation of air, water and environment. However, in order to mitigate their hardship, we would direct the Government of India and the State of Uttar Pradesh that whenever any other area in the State of Uttar Pradesh is thrown open for grant of lime stone or dolomite quarrying, the lessees who are displaced as a result of this order shall be afforded priority in grant of lease of such area.
>
> "We are conscious that as a result of this Order made by us, the workmen employed in the limestone quarries will be thrown out of employment. But the limestone quarries which have been or which may be directed to be closed down permanently will have to be reclaimed and afforestation and soil conservation programme will have to be taken up in respect of such limestone quarries and we would therefore direct that immediate steps shall be taken for reclamation of the areas forming part of such limestone quarries with the help of the already available Eco-Task Force of the Department of Environment, Government of India and the workmen who are thrown out of employment in consequence of this Order shall, as far as practicable and in the shortest possible time, be provided employment in the afforestation and soil conservation programme to be taken up in this area."

instances permission has been given for felling forests on a large scale when the government faced serious political problems like the fall of a state government.

Members of the Congress(I)-led ruling coalition in Kerala forced the Central government to agree to distribute title deeds to forest encroachers in Idukki district. The title holders were exempted from the provisions of the act in their settlement. The Prakrithi Samrakhana Samiti, a voluntary organisation from Kerala, pointed out that this deed has already encouraged several other encroachers in the adjoining areas of forest land in Idukki district. The Samiti also points out that this decision violates the interim stay order issued by the Kerala High Court in December 1983 to stay all proceedings to assign any portion of this forest to encroachers.

There should be a provision for involving people in the implementation of this act. Several voluntary groups involved in fighting deforestation could find this act extremely useful. A voluntary agency in Pune, for instance, has appealed to the Central government to stop further destruction of the tropical evergreen rainforest of Bhimashankar, about 150 km from Pune. The state public works department is keen to construct a two-lane metal road through this majestic forest, which has been a preservation plot of the forest department since the 1930s, because it wants to reduce the distance from Bombay to Bhimashankar, an important pilgrimage centre, by about 100 km. Alternative routes skirting this forest are available. But still in 1980-81 some 1,500 metres were clearfelled in contravention of the Forest (Conservation) Act under the excuse that the road was being built under the unique Employment Guarantee Scheme. When voluntary agencies protested, further tree-felling was banned by the state's forest department but ministers intervened to force the District Planning and Development Council in early 1984 to permit clearfelling of the forest again. Pune's environmentalists have now appealed to the inspector-general of forests in the Central Government to ensure that the Forest (Conservation) Act is strictly adhered to.

Not surprisingly, several state governments have expressed unhappiness with the act as it holds up the implementation of development projects. An amendment was moved in Parliament in 1982. The amendment resolution sought to make it compulsory for the government not to withhold its approval for forest felling for public utility services such as roads, drinking water schemes, telephone lines and electricity lines. The resolution also wanted that schemes approved by state governments, when sent to the Central government for its approval, should be disposed of by the Central government within 15 days of receipt. Fortunately, this amendment was not carried through. A wider dialogue and more detailed information on the implementational aspects of the act are urgently needed.

## Environmental litigation

A common feature with environmental laws is that they exclude people in their implementation. The enterprises which profit at the expense of the environment are always well represented and their interests always well-protected.

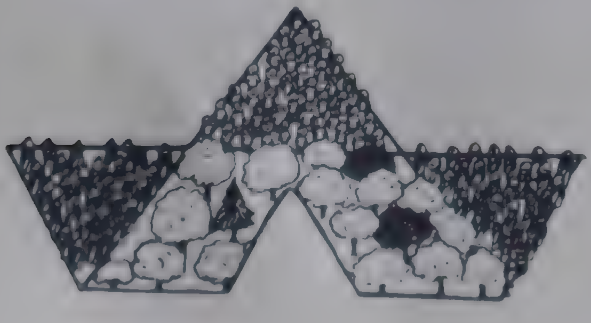
Different groups have attempted, with varying degrees of success, to invoke political and legal processes, and to a much lesser extent judicial processes to control environmental degradation with varying degrees of success. Unfortunately, legal means, when attempted, have often been found inadequate. What kind of changes would best suit Indian conditions? Indian problems are complex and defy any ready-made "importation" of administrative or legal frameworks from abroad. So it is essential that the solutions suggested should be such that they fit into Indian conditions. India does not lag behind many countries in adopting or proposing to adopt environmental legislation.

In all the recent environmental legislation, provision is made to represent certain interests like industry that are likely to be affected by the decisions of the implementing agencies. If these interests are not satisfied with the decisions of the implementing agency, provision has been made for appeal. But the individual affected by pollution or apprehending pollution is neither given any representation nor the right to move any court as a matter of course. As a result the person affected by pollution can only have recourse to the provisions available in the Indian Penal Code and other acts where criminal prosecution is provided. Of late recourse is taken also to the writ jurisdiction of the courts.

But how have the courts responded? Have they tried to give a narrow interpretation following the letter of the law or a wooden intepretation laying emphasis more on the spirit of the law and thus help in the positive growth of environmental jurisprudence in India?

Courts have a very important role in the protection of environment. Unfortunately, the case law available does not reflect the enormity of legislation available on the subject. If we look at litigation contested on the basis of legislation that cannot be called environmental *stricto sensu*, we can find cases, however scarce, on the important aspects of environmental protection like water, air and noise pollution. However, these cases came before the courts not to contest the action taken under various acts, nor even to contest the industry's "right" to pollute the environment as they wished, but on grounds which touch the problem only remotely.

Of the five pieces of legislation that can be broadly described as environmental, the maximum amount of case law can be found on the decisions of the Central and state boards constituted under the Water (Prevention and Control of Pollution) Act, 1974. It is interesting to study those cases which have been launched by individuals against either a governmental agency or a polluting industry.



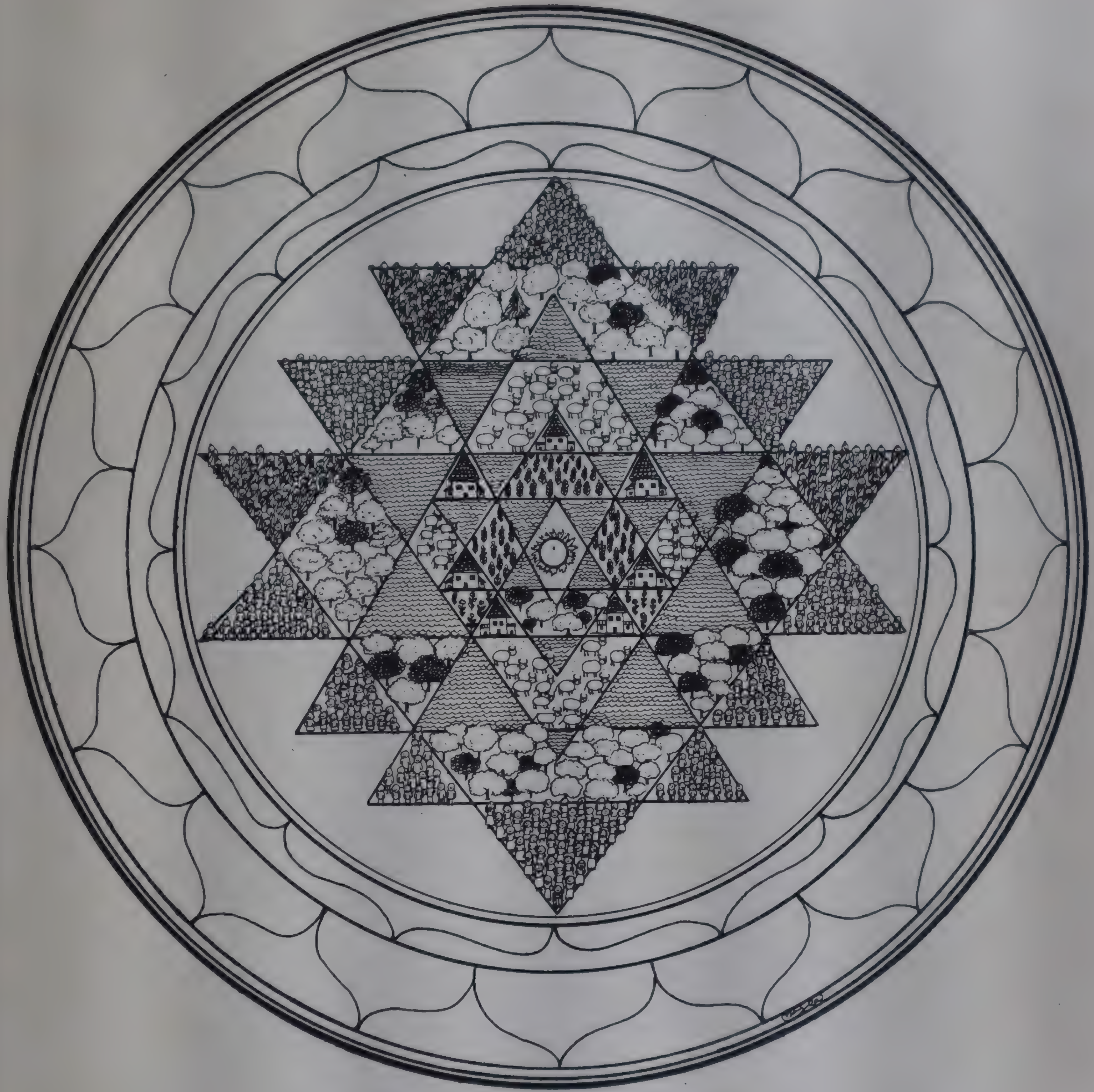
A brief look at the water act indicates that the concerned citizen is not represented in decision-making. This may be due to doubt in the minds of the framers of environmental legislation that if concerned citizens are given the right to be represented on the Central and state pollution control boards, they would make the job of the boards extremely difficult. This fear appears to be based on the fact that generally citizen action is most frequently found to be directed against the duly constituted authorities of government. But experience in the more developed countries shows that environmental litigation is as much against the polluting industry as the government or its agencies.

Central and state pollution control boards can actually benefit by the people's constant vigilance. This can be achieved by helping increase public awareness, by giving them representation on the boards, and providing them with the required locus standi to fight cases on their own or through non-governmental organisations. Till this is done, the courts should liberalise the locus standi principle to the extent possible and help environmental litigation. In certain cases, the principle was actually liberalised. Of particular importance in this regard is the judgement delivered by the Supreme Court in Municipal Council, Ratlam vs Vardhichand.

In this case the residents of a locality within the limits of Ratlam Municipality, tormented by the stench caused by open drains and public excretion moved the magistrate under Section 183 of the Criminal Procedure Code to require the municipality to do its duty towards the members of the public. The magistrate gave direction to the municipality to draft a plan within six months for removing the nuisance.

In appeal, the sessions court reversed the order. The high court approved the order of the magistrate. In further appeal, the Supreme Court also affirmed the magistrate's order. This was perhaps the first time the responsibility of a civic body for the protection of environment was so openly acknowledged. In the light of this decision, many lower courts followed suit and many municipal authorities were issued notices to take measures to arrest the public nuisance. In Dasari Koteswara Rao and others vs The Kolleru Paper Mills Ltd., the Andhra Pradesh High Court allowed a writ petition moved by 45 people residing in the polluted area and directed the respondent to stop releasing the factory effluents into the canal.

Such examples apart, in all other cases where enforcement is sought through criminal procedure, the courts are concerned with the capability of the defendant rather than the condition of the environment. In many cases the courts were unwilling to recognise violations as true crimes and regarded them rather as breaches of social welfare standards. Either the courts did not award punishment where the criminal intent or knowledge was not found, or awarded such petty fines, that it works out much cheaper for the industrialist to go on paying the fine rather than buy pollution prevention equipment. The need of the hour appears to be to reorient the judiciary, mainly at the magistrate level and above, to the problems of environmental pollution and the responsibility of the present generations to the future.



# POLITICS OF ENVIRONMENT

*The phenomenon of environmental destruction cannot be properly understood without examining the political economy of natural resource use within the society. This understanding is needed not only to find appropriate and lasting solutions to the problem of environmental destruction, but also for finding appropriate strategies for social and economic advancement. The following chapter presents two esays on the politics of environment. The first essay has been written by Dunu Roy of the Shahdol Group, a major author of Planning the Environment, a detailed study of current and possible alternative patterns of natural resource exploitation in the Shahdol district. The second essay has been written by Anil Agarwal, one of the editors of this report.*

झारखण्ड मुक्ति मोर्चा

**"many environmental groups and organisations of people are attempting to give a new direction to the protection of the environment. Among them ... the movement against Sagwan (teak) in Jharkhand ..." (Krishna Murari Krishna/India Today)**

# POLITICS OF ENVIRONMENT—I

In the social system of India 1985, environmental myopia would appear to be a societal disease. Nothing else can explain why the railway passenger should spit and scatter monkey nut shells and pour water on the floor; public lavatories should be used as if they were the last chance before the deluge; smokers should choose to wilfully ignore the little red warning printed on each packet of cigarettes; or why people should foul the air and water that they breathe and drink. What is the disease ? What makes it so rampant and so dangerous?

Depending upon the glasses they wear, different persons give three different answers to this question. The first says that environmental concern is a conspiracy of the developed First World against progress in the Third, and that environment will become an issue of importance only when underdeveloped countries reach the levels of production and consumption of industrialised nations. The second argues strongly that all this nonsense about preserving the tiger and the aesthetic beauty of green belts is diverting attention from the problems of the poor, and that the environment has nothing to do with trying to give a better deal to the large and ever-growing population. The third, in a paradoxical turn, holds this very same large and ever-growing population responsible for the environmental crisis, maintaining that there is too little of everything except people. All these three positions illustrate only too vividly how little is understood of ecobalances and the interpenetration of different systems in a generalised world market. Let us examine each briefly.

The first person presents arguments that environmental concerns are the business of the rich countries which cause most of the pollution, and moreover have the wealth to cure it. Debates on doomsday theories, limits to growth, the population explosion, and the conservation of nature and natural resources are said to be largely academic, and of no great interest to those faced with the daily realities of poverty, hunger, disease, and survival. Indeed, environmental concerns could well retard development efforts in the developing countries.[1] In response to these arguments it is pointed out that environment and development are not necessarily incompatible, that developing countries in the arid zones and humid tropics have always had to deal with natural environmental problems such as droughts or water-borne diseases, which have materially affected their development. Another thread of this argument is that many problems confronting developing countries had been encountered earlier by developed countries, whose mistakes could be avoided.

On the basis of such arguments the United Nations Conference on the Human Environment convened at Stockholm in June 1972 gave birth to the notion of "Ecodevelopment"—a word coined to describe a process of ecologically sound development, of positive management of the environment for human benefit. In addition, the phrase "the pollution of poverty" came into being to describe the worst of all the world's environmental problems, referring to resource deterioration, squalid housing, and inadequate sanitation.[2]

Somewhat similar arguments are posed by the second person. To the position that pollution does not matter to the poor, it is pointed out that poverty creates tragic sequences of environmental deterioration leading to greater poverty. For instance, the cultivation of marginal land by the poor leading to soil degradation and consequently further impoverishment of the cultivator is an obvious example.[3] Another is the increased exploitaton of the forest for firewood by the poor for sale in the towns leading to depletion of firewood supplies and greater hardship for the poor. Thus, being at the bottom of the social and economic ladder, the poor get the worst of everything, including pollution. They are the worst affected by impure drinking water, accidents, insanitary living conditions, pollution, disease and so on, simply because they have no alternatives.

The bogey of population pressures leading to environmental degradation, raised by the third person, is an old one. Forest officials, in particular, have consistently blamed villagers for destroying forests while municipal officers and politicians blame slum dwellers for dirt and disease in cities. What is not accepted by them is that villagers and slum dwellers have no options. The space that they occupy and the resources that they have been using have been gradually taken away from them and no additional resources provided. With the depletion of forests, alternative energy sources have not been made available to the poor. Sanitary facilities and drinking water remain desirable but are remote objectives for all slum dwellers. The problem is not so much of the poor destroying the environment by their sheer numbers as that they are deprived of their share in the distribution of resources. For instance, India is now in a position to feed its entire population from areas of intensively irrigated agriculture[4] but since marginal peasants are deprived of access to food they are constantly searching for land to grow crops on and continued cultivation of this land without adequate inputs merely renders it more and more unproductive.

It should, therefore, be clear that there are factors other than poverty and population which are responsible for the pollution of the earth. The 1972 Stockholm conference generally assumed, in a spirit of hope and confidence, that the limiting factors were scientific and economic. But ten years later, there was a growing recognition that "many of the great problems of the world environment have political roots". What these *political* roots are has never been explicitly stated but, on the one hand, it is again assumed that," Stable administrations, supported by popular consensus, are needed if long-term environmental developments are to proceed and resources are not to be dissipated in strife and preparations for war". In other words, political stability is necessary for environmental action. On the other hand, there is also an awareness that, "the capacity of any existing economic system to bring about the necessary social and environmental developments has been challenged in many quarters, especially following the energy crisis of the 1970s".[5] This line of reasoning may be all very well but the point is not merely what kind of political and social system is *necessary* for preserving the environment, but what is *sufficient?*

We must examine the Indian case in greater details in order to understand why environmental degradation takes place, why it is not controlled, and what is the role of "politics" in it. Partly, of course, the problem is one of ignorance of how ecosystems work. This ignorance begins to be challenged when the environment begins to show obvious signs of misuse and problems are created for production and survival. A classic example of this is the entire exercise in flood control in the Gangetic basin. Flooding of the Gangetic plains during the monsoons is not new. But in the past the population was prepared for this phenomenon with houses being built on high ground and the flood waters being permitted to spread over the land so as to deposit valuable silt on the farms. However, with increasing demands being made on the land and the population spreading to undertake agricultural activity, particularly with greater irrigation and inputs into intensive agriculture, the coming of the floods began to take problematic dimensions. There was both loss of life and property as well as devastation of standing crops. The problem was compounded by the felling of trees in the lower Himalayas and, therefore, increased loads of water and silt that the rivers had to carry. For instance, in 1978 it was computed that the Ganga was the second largest sediment bearing river in the world, and, in terms of sediment load in relation to the size of the drainage basin, the Kosi ranked fourth and the Ganga fifth.[6]

Consequently, the Government of India, with its centralised planning machinery, decided to go in for flood control measures through a series of dams in the upper reaches and embankments in the plains. These worked well enough for a few years but soon the problem re-emerged in worse shape. With increased siltation loads, reservoirs behind the dams began to fill up and dam capacities lessened. Consequently, dams had to discharge greater quantities of water than designed leading to further flooding. Secondly, the silt began to settle in river beds as it was prevented from spreading into surrounding farmland because of embankments. Thus river beds slowly became even higher than the surrounding area and floods took on an even greater magnitude as the old drainage patterns would no longer work. Thirdly, the land beyond embankments could no longer drain into the river and so became marshy and saline. In sum, the intervention by humans to control floods led to even greater environmental degradation as ecosystems had not been understood properly.

Similarly, the impact of Green Revolution techniques in increased food production had been anticipated but no account had been taken of the effect in other areas. For instance, the development of fodder resources has been almost totally neglected in the country's development strategy. Crop residues from the traditional tall varieties of cereal crops were an important source of fodder for animals. The introduction of shorter high-yielding varieties has seriously cut into this source. The other fodder source was from village grazing lands and other public lands. These have been extensively encroached upon for cultivation and the remaining lands have been overgrazed, eroded, and otherwise remained unproductive.[7] Curiously enough, even where fodder cultivation was encouraged with the introduction of the White Revolution in dairy, nobody anticipated that the fodder growers would change cropping patterns on irrigated land from cereals to fodder, thus leading to a shortfall in food production in the village. Wheat, which had been previously grown and consumed locally, was now giving way to fodder which went into milk production which, in turn, was exported to the city.

However, we cannot attribute environmental awareness to hindsight alone. There was plenty of foresight too. A case in point is the Damodar Valley Corporation (DVC). A

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(Bhawan Singh/India Today).

precursor of the many multipurpose projects in the country today, the DVC was patterned on the famous Tennessee Valley Authority (DVC) in the USA. The chief engineer of the TVA was, in fact, the chief adviser to the DVC. The project was framed as a series of nine dams in the upper reaches of the Damodar Valley and its tributaries. It was expected that these dams would both supply water for irrigation as well as hydel power for industries in the Dhanbad-Asansol industrial belt—the so-called Ruhr Valley of India. Furthermore, there would be a degree of flood control in the lower reaches in Bengal. Prosperity would be widespread and reach out to the poorest person.

In a brilliant piece of analysis when the project was still at its nebulous proposal stage, a civil engineer in the Bengal services pointed out many fallacies in the reasoning behind the project.[8] Giving details of how the construction of any obstruction in a river course—be it bridge, dam, or weir—creates problems in the ecosystem unless properly studied and designed with reference to local parameters, Kapil Bhattacharya proceeded to analyse the Damodar river valley and the environmental impact of the DVC. He suggested that the construction of the nine dams would extensively affect the natural flow of the rivers and, therefore, their sediment carrying capacities. They would no longer be able to act as huge flushing systems for sweeping out the sediment into the Bay of Bengal but would deposit the silt in the river beds themselves giving rise to the increased incidence of 'chars' which would further distort the flow patterns of the Chhota Nagpur plateau; the sediment loads would increase and further exaggerate the problem. Even the dams lifespan would be reduced, as would be the hydel generating capacity, with frequent breakdowns of the power generating equipment because of erosion of moving parts. This would obviously affect the proposed industrial development.

Focussing on the downstream siltation, Bhattacharya predicted that the Damodar would deposit a considerable portion of its silt in the Hooghly instead of flushing the Hooghly as previously. This would adversely affect the flow of the Hooghly as well as the deepwater port in Calcutta. A new port would have to be constructed much further downstream. Secondly, the sewage drainage patterns of the city of Calcutta into the Hooghly would become useless and the municipal authorities would have to pump the sewage into the low-lying land in East Calcutta. Even dredging the Hooghly at vastly increased cost would not be of much help. Thirdly, this would entail the diverting of water into the Hooghly to maintain its flow which could only be done by constructing a barrage near Farakka.

But Bhattacharya, incredibly, did not stop short at looking at the natural environment. He also cast an analytical eye over the social situation. He, for instance, ridiculed the whole notion that the local tribals would benefit from the construction of the DVC. For modern industry and agriculture, he foretold, skilled labour would be required which would come from outside the area. The tribals would be reduced to the status of construction and contract labour bearing the heaviest load of exploitation in their own land. The hydel generating plants would not function effectively, he said, and for this the "blame" would be put on the engineers and the workers for being "lazy" and "inefficient". The construction of canals for irrigation would eventually not fulfil the function for which they were designed as there would be a shortage of water anyway and coupled with competitive use by industry and the silting of the reservoirs and the river bed, irrigation would suffer. Thus, agricultural development would not take place as anticipated and for this the "unenterprising" farmer would be held responsible. When the sewage and drain waters of Calcutta would begin to pollute the city because they would not drain speedily into the Hooghly, the municipal workers would be taken to task for not maintaining the city. Even the construction of a second port at Diamond Harbour or Haldia would mean added time lost in offloading from ocean-going vessels at this new port into smaller vessels for transporting to Calcutta. For this loss in time and money, the dock workers would be pressurised to increase the intensity of work. And, finally, the construction of a barrage at Farakka for diverting the water of the Ganga into the Hooghly would create tensions with Bangladesh (then East Pakistan).

What is striking about this whole analysis is that it was done long before a single foundation stone was laid for the DVC. Every one of the predictions made in the analysis has come true and has led to increased tensions regionally,

"Mining is a devastating operation that destroys the natural ecosystem . . . The associated problems of deforestation, waste disposal, water pollution, air pollution, derelictions, vibrations from blasting, land collapse, and drops in water table are marked." Tribals are forced to dig for drinking water with the Karo river polluted by mine wastes. (Pramod Pushkarna/India Today)

nationally, and internationally. What is perhaps most disturbing though, is that nobody, either in the government or out of it, in the trade unions or the tribal organisations, paid any attention to Bhattacharya at the time. The thrust by the Centre and the international aid agencies was too powerful, the attraction of DVC was too great, the expectations of prosperity too widespread. Even today few people are aware of this magnificent contribution to environmental impact analysis and forecasting made over 30 years ago.

Other analyses of various projects have been made but few, if any, have been as wide ranging as this. For instance, a study of the Bedhti project in Karnataka[9] has shown that the cost-benefit analysis is without foundation as the costs in the project proposal have been grossly underestimated and the benefits overestimated. Hence, in actual fact the project would not be economically feasible. Even otherwise, the study attempts to show that the benefits accruing from the use of power will not go to the poorer masses as it will be fed into the centralised national grid to be used by industries in other parts of the state and the nation. In addition, the figures show that the employment opportunities generated will be less than the employment opportunities lost as a result of submergence, and it emerges that the social and environmental disruption will be much larger than the socio-economic growth created by the project.

Another analysis of the NALCO aluminium project proposed to be set up in Orissa raises similar questions about the feasibility and the cost-benefit ratio of the project as prepared by a French transnational. It also points out that there are major environmental problems associated with the bauxite alumina operation.[10] Mining, as a recent study in Madhya Pradesh discloses,[11] is a devastating operation that not only destroys the natural ecosystem, particularly if it is surface mining, but also introduces tremendous distortions into the social fabric. The associated problems of deforestation waste disposal, water pollution, air pollution, dereliction, vibrations from blasting, land collapse, and drop in water tables are, of course, marked and perhaps to be expected in any mining operation. But little attention has been paid to the fact that most mining is in remote tribal areas and the impact on health, hygiene, nutrition, sanitation, accidents, increased intensity of work, market prices, prostitution, and anti-social activity is a necessary corollary of mining as it is being practised today. Nationalisation of all mining has only created a larger and more powerful centralised apparatus contributing to environmental degradation on a more massive scale.

Forests, of course, are the first victims (along with rivers) of environmental imbalances. The announcement of a new Forest Bill has, consequently, aroused the wrath of those who have been closely associated with forests and tribals.[12] Before 1855, the forest dwellers had complete freedom to exploit forest wealth. On August 3, 1855 the British, on the basis of the report of the then superintendent of forests in Burma issued a memorandum providing guidelines restricting the rights of forest dwellers to conserve the forests. This was further modified in 1894. It was said that "the sole object with which State forests are administered is the public benefit". But, in actual practice, the "public" in this case essentially meant British interests who required wood to meet the demands of the two World Wars and the building of the railways in India. The Forest Policy of the Government of India (1952) is an extension of this policy. This policy prescribes that the claims of communities near forests should not override the national interests. And the proposed new Forest Bill takes this process a step further by maintaining that the "free supply of forest produce to the rural population and their rights and privileges have brought destruction to the forests and so it is necessary to reverse the process". In other words, the rural population is to be completely denied access to the forests and their produce in the national interest.[13] But, in spite of this concern for the forests the National Forest Policy has not been successful in protecting the ecosystem. According to a UN estimate, 50 per cent of the total land area in India is seriously affected by water and wind erosion. About four million hectares of land

**"Why is it even though research clearly indicates that a combination of oxidation ponds and anaerobic and aerated lagoons are not only effective but economic techniques for the treatment of paper mill effluent, no paper mill cares to install the full equipment." (A Kothari)**

is lost to ravines and erosion along mountain roads causes frequent landslides.

What, therefore, emerges is that in spite of, or perhaps because of, increasing centralisation of power and authority, the environment is being further degraded at a faster rate. This is true not only of forests and mining and water resources but of all resources. There is even a threat of water pollution to the Great Indian Desert.[14] This is emerging from the polluted effluents being discharged by over 1,500 dyeing and printing units into the dry riverbeds and nullahs around Jodhpur, Pali, and Balotra towns. In the name of development, the growth of these units has to be encouraged for the tourist trade.

A study of hazards gives an even better insight into how, in spite of centralised planning and development, accidents and injuries affect the poor.[15] Citing the case of 16 workers dying in the process of the construction of the Mahatma Gandhi Setu and the subsequent advertisement by the authorities in the newspapers announcing the "supreme sacrifice" of these "martyrs", the author of the study remarks that it almost seems as if "human sacrifice is necessary for any major achievement. I am sure that the families of those unfortunate labourers do not think that their near and dear ones are heroes to die on a construction site".

Examining the pattern of deaths due to accidents the study discovers that the kitchen is one of the most unsafe places in the home because there is no policy decision to replace pressure stoves by other alternatives. In occupational injuries, the gross injury rates in Indian factories are much higher than in Europe. The total number of accidental deaths for workers could be anywhere from 6,000 to 18,000 persons every year and 60,000 to 360,000 serious injuries. The development of Green Revolution techniques in Punjab still cannot prevent 0.63 accidental effluent, no paper mill cares to install the full equipment ?[19] Why is it that while it is known that the energy requirement for recycling aluminium is some 3 per cent to 4 per cent of that required to concentrate the metal in usable form from deaths and 5.0 cripplings per 1000 population (in non-mechanised rural Punjab). Extrapolated to the rural population of India, this comes to 316,000 killed and 2.5 million crippled every year. The author makes a strong argument for treating "injury" as a "disease" at a policy level so that it can be analysed and prevented accordingly. At present the thrust of the investigations into accidents is to determine whom to blame.

Such pleas are likely to fall on deaf ears, going by previous experience. Why ? Why is it that even though a host of data, statistics, and experience is mustered to back arguments about the protection of the environment, those in authority pay no attention, and even when they do and policy is framed, it is never implemented in the way the policy is designed? Why is it that in the central Indian forest belt, the governments of Madhya Pradesh, Orissa, Bihar and Andhra Pradesh, all practising commercial forestry, have leased out large tracts of forest to big business houses[16]? Why is the World Bank heavily financing social and commercial forestry and insisting on repayments within 11 years so that eucalyptus becomes the only tree that will grow fast enough to repay the loan?[17] Why is it that the Bombay Environmental Action Group makes a plea for locating the new Tata thermal power unit in a backward area of Maharashtra[18] instead of in Bombay, even though there is sufficient evidence to indicate that setting up industrial units in backward areas does far more harm than good to the local inhabitants ? Why is it that even though research clearly indicates that a combination of oxidation ponds and anaerobic and aerated lagoons are not only effective but economic techniques for the treatment of paper mill ore, and the comparable figures for magnesium and titanium are 1.5 per cent and 30 per cent respectively, official policy does not emphasise the need for recycling materials?[20] Why is it that while tribals and villagers are blamed for forest degradation, it is industry which gets encomiums for preserving forests (for their own use), even though it is clear that when the villagers owned the forests they looked after them equally well, if not better?[21]

To find an answer to these questions it would be revealing to counterpose the environmental legislation produced by the government against the environmental actions undertaken by groups of people. Under the earliest legislation during the British Raj, there was a provision in the Indian Penal Code that permitted district magistrates to take punitive action against those found polluting any public water source. Subsequently, various standards, building codes, nuisance acts, municipal acts, factory acts, and inspection schedules were laid down. In spite of all this, as late as 1971, the Central Public Health Engineering Research Institute at Nagpur blithely reported that out of 2540 cities and towns, only about 1200 had a modern water supply, less than 200 had underground drainage and two had complete sewage treatment plants: a revealing picture of the concern for public health. In 1974, the government enacted the Water Pollution Control Act. What this Act did, in substance, was to centralise investigatory and prosecutory powers in the water pollution control boards and prohibit anybody else from taking legal action through the courts. The same holds true of the Air Pollution Control Act and the new Forest Bill. These acts take control away from a host of earlier legislation embodied under common law, municipal acts, the Factories Act, Indian Penal Code, Criminal Procedure Code, etc—all available to the public-spirited citizen.[22]

Not that centralised legislation will necessarily solve the problem. This is what Ralph Nader had to say, in 1971, about the US experience: "The federal role in water pollution control began in 1948 on a temporary trial basis and became permanent in 1956 . . . . Beginning with the drafting of the water pollution legislation, the federal effort grew into a complex charade. The built-in procedural delays exceeded the professional avarice of the most adamant of corporate lawyers. The delegation of initiatory moves to the states ensured the availability of a 'divide-and-rule' tactic by industry vis-a-vis already subservient and underequipped state agencies . . . . .Hundreds of millions of dollars of construction grant subsidies flowed from Washington to local governments for waste treatment plants which industry promptly used to dump more waste through. This subsidy to local industry turned into a subsidy to factories that increased water pollution . . . . Its (the federal government's) effectiveness to date can be concisely assessed by the virtual absence of any evidence that the seven laws passed and more than 3 billion dollars spent by the federal government has reduced the level of pollution in any of our country's major bodies of water, so that they are once again suitable for human use . . . ." The same patterns can be seen emerging quite clearly on the Indian scene, but those in authority never seem to learn from history.

On the other side of the coin are the many environmental groups and organisations of people which are attempting to give a new direction to the protection of

the environment. Their very presence indicates that the much-vaunted government effort has failed miserably. Among them are the Chipko and Appiko movements in Uttarakhand and Uttar Kannara to protect trees from felling; the effort to save the Silent Valley from submergence; and the movement against Sagwan (teak) in Jharkhand and against pine in Bastar. There are numerous local protests against land being submerged by large dams, against ponds being taken over by contractors, and against mining activity despoiling farming land. Even in the industrial belt, there is a growing awaréness of the hazards to which workers are increasingly prone. Safety measures and compensation, shorter working hours, bathing facilities and medical assistance, almost all the provisions on the law books, are being increasingly demanded by militant associations of workers. Possibilities of joint actions by villagers and workers are also merging over water pollution, air pollution, and employment opportunities using appropriate technologies. Much of this effort is being aided by a different breed of scientists and academics who identify with the aspirations of the people and attempt to find the scientific evidence needed to back up these aspirations.[23]

The response of authority almost invariably seems to be to deny that problems exist at all and when public pressure grows, to introduce legislation which further centralises powers in the "national interest."[24] What exactly this "national" (or "public") interest is has to be deciphered from an understanding of who eventually benefits.[25] The conflict between the associations of the people and the vested interests who stand behind policies and legislation is getting sharper if the evidence of tensions being reported in the press is any indication. And in their own way, these conflicts are making manifest the basic politics of the environment. Who eventually will win in the race to protect or degrade the environment is a question that many of us will have to answer both in theory and in practice.

**Dunu Roy**

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### References & Footnotes

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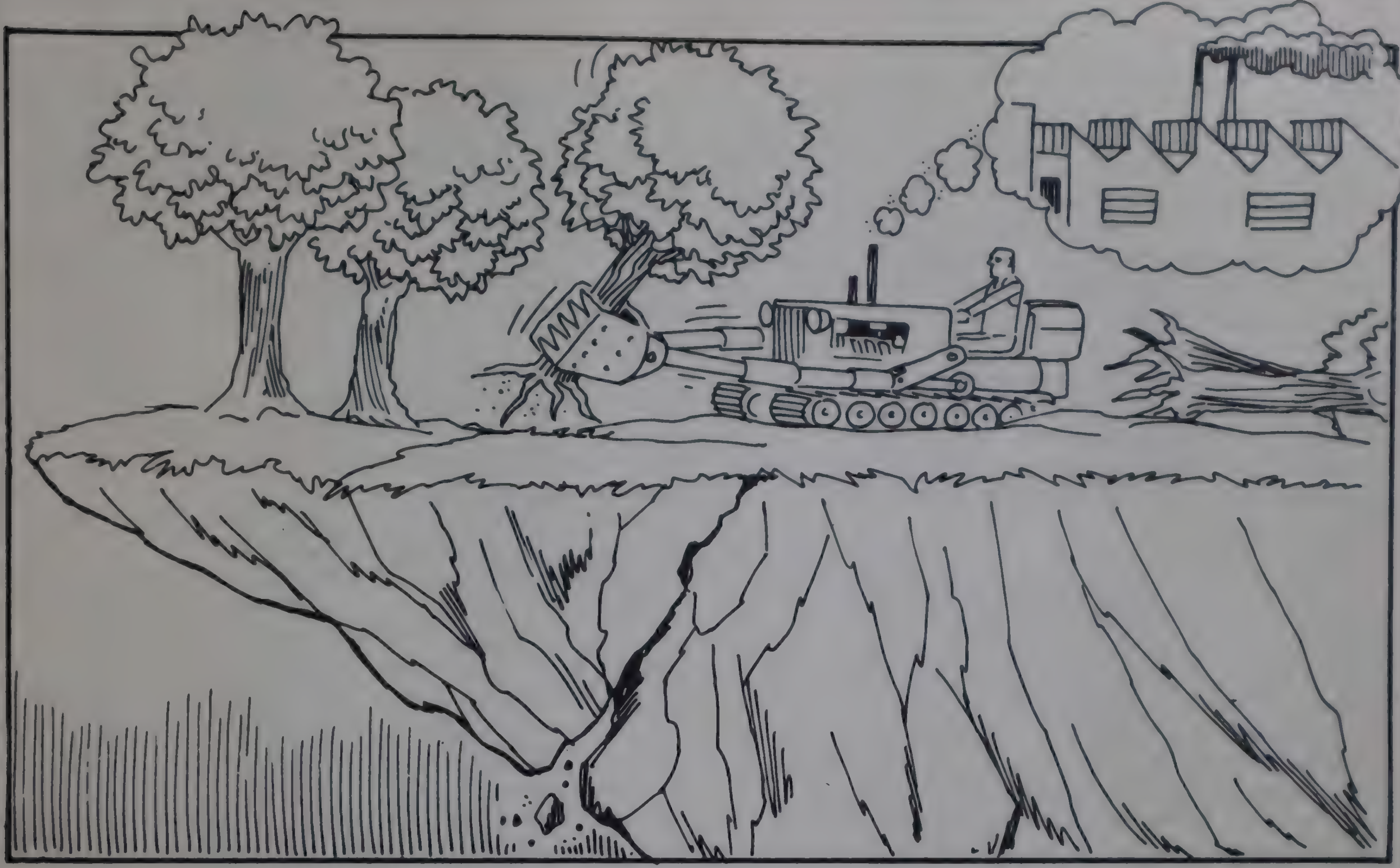
22. Bose, Asit, Legal Control of Water Pollution in India, Indian Institute of Management, Calcutta.
23. For several examples of people's initiatives, see State of India's Environment: A citizens' report, Centre for Science and Environment, New Delhi, 1982.
24. This manner of response is true for other issues also; for example, the spate of dowry deaths and rape cases and increasing protests by women's organisations has resulted in more centralised legislation, against which women's organisations are again protesting.
25. For instance, the Bombay Municipal Corporation resorted to series of forcible evictions of slum dwellers from municipal land to save the "the health of the citizens of Bombay" until it was pointed by voluntary organisations that 60 per cent of the "citizens" of Bombay lived in slums.



# POLITICS OF ENVIRONMENT—II

It looks as if environment is an idea whose time has come. Newspapers give prominent display to environmental horror stories. Editorials demand better management of natural resources. Government statements on the need to preserve the environment are commonplace. Government programmes too are quite numerous and increasing in number day by day. There are massive schemes for afforestation, for instance. In the last four years, some 1000 crore seedlings are said to have been distributed or planted. There are new laws for control of air and water pollution and for the conservation of forests. India has been praised all over the world for what it has done to preserve tigers. Nearly 3 per cent of India's giant land mass is now protected national parks and wildlife sanctuaries, and there are demands to strengthen their protection and increase their area. Plan documents and party manifestoes take care to mention the importance of environment.

But there is a major problem with this entire range of activities and concerns: it does not appear to be based on a holistic understanding of the relationship between environment and the development process in this country. The programmes are ad hoc, without clear priorities, and there is too much of a policeman's attitude. They seem to be based on the belief that concern for the environment essentially means protecting and conserving it, partly from development programmes but mainly from the people themselves. There is little effort to modify the development process itself in a manner that will bring it into greater harmony with the needs of the people and with the need to maintain ecological balance, while increasing the productivity of our land, water and forest resources.

The post-independence political debate in India has centred on two major issues: equity and growth. The environmental concern has added a third dimension: sustainability. India's biggest challenge today is to identify and implement a development process that will lead to greater equity, growth and sustainability.

The environment is not just pretty trees and tigers, threatened plants and ecosystems. It is literally the entity on which we all subsist, and on which entire agricultural and industrial development depends. Development can take place at the cost of the environment only uptil a point. Beyond that point it will be like the foolish man who was trying to cut the very branch on which he was sitting. Development without concern for the environment can only be short-term development. In the long term, it can only be anti-development and can go on only at the cost of enormous human suffering, increased poverty and oppression. India may be rapidly approaching that point.

Amongst the hundreds of voluntary groups working at the micro level in India, there has been a remarkably rapid growth of interest in environmental problems. So rapid has been this growth that sometimes it is loosely described as the beginnings of an environmental movement in the country.

Hundreds of field-level groups today take a keen interest in environmental issues and their experiences and interests are extremely diverse. Some are interested in preventing deforestation. Others are interested only in afforestation. Many want to prevent the construction of one dam or another. There are others who want to prevent water pollution. There is the famous Chipko movement[1] in the UP Himalayas, probably the oldest and most famous of all the groups, which has played a major role in bringing the issue of deforestation to the forefront of public opinion. Now there is its counterpart in the south, the Appiko movement[2] in the Western Ghats of Karnataka. Dams like the Silent Valley[3] and Bedthi[4] have already been stopped because of strong people's protests and well-known social worker Baba Amte is leading a major campaign against the proposed Bhopalpatnam and Inchampalli dams[5] on the borders of MP, Andhra Pradesh and Maharashtra. The Kerala Sastra Sahitya Parishad[6] has had a long acrimonious battle over the pollution of the Chaliyar river in Kerala by a rayon mill. The India Development Service finds itself embroiled in another case of river pollution by a rayon mill in Karnataka[7]. Meanwhile, the Shahdol Group has worked against the pollution of a river in the Shahdol district by a paper mill[8]. There is, of course, the Mitti Bachao Abhiyan[9] to organise the farmers against the waterlogging caused by faulty irrigation systems.

While all these are relatively well known groups and have attracted varying degrees of media attention, there are many, many others which are doing excellent work in mobilising people, both to prevent further ecological destruction, often in the face of determined government policies, and to bring about ecological regeneration. One thing, however, that binds most of these group's is their concern to put the environment at the service and the control of the people, the people usually being defined as the local communities who live within that environment.

Environmental protection per se is of least concern to most of these groups, including the well known Chipko movement, for example. Their main concern is about the use of the environment: how should the environment be used and who should use it and benefit from it. It is this growing understanding of the relationship between the people and their environment, born out of a concern for a more equitable and sustainable use of the environment, that is probably the most fascinating development in India today.

**"Environmental protection per se is of least concern to most of these groups, including the well known Chipko movement, for example." (C.P. Bhatt)**

## Environmental destruction by the rich

To understand the nature of the environmental problems in India, it may be useful to compare and contrast certain environmental trends and concerns in India with those in the West, especially since the environment crusade began in the West and since many groups in India, including political parties, have for long dismissed it as a petty Western concept. The argument has always been that too much concern for the environment can only retard economic and industrial development.

The UN Conference on the Human Environment held in Stockholm in 1972 was the landmark conference that created worldwide consciousness about the environment. No UN conference has ever been able to collect so many luminaries at one place.

Many delegations from developing countries had argued that the solution to environmental problems lay in economic development. "Smoke is a sign of progress," the Brazilian delegation had thundered, then representing a country witnessing an economic boom. India's Prime Minister Mrs Indira Gandhi, who made a major impression on the conference, is still remembered for her oft-quoted statement: "Poverty is the biggest polluter." In all those who came from the Third World, both leftists and rightists, there was a sneaking suspicion that the Western countries were up to some trick. The West may simply be pushing the environmental concern onto an unsuspecting Third World to retard its technological modernisation and industrial development. It was even argued that having got their riches and their affluent lifestyles, Westerners were now simply asking for more affluence: clean air, clean water, and large tracts of nature for enjoyment and recreation, many of which were going to be preserved in the tropical forests and savannas of Asia, Africa, and South America.

But exactly ten years later when the UN organised a meeting to commemorate the Stockholm conference, few non-governmental groups from the Third World were prepared to argue in favour of the development process as it is. The Third World today faces both an environment crisis and a development crisis, and both these crises seem to be intensifying and interacting to reinforce each other. On one hand, there does not seem to be any end to the problems of inequality, poverty and unemployment, the crucial problems that the development process is meant to solve. On the other, environmental destruction has grown further apace. But what is interesting is that while many environmental problems, especially those related to air and water pollution have tended to become less severe in many parts of the industrialised world, because of the introduction of highly capital-intensive pollution control technologies, these problems have continued to grow and become critical in many parts of the developing world. In other words, while the economic development process in the world is only worsening our environmental problems, it is tending to solve them in the West. Michael Heseltine, then Minister of Environment in the anti-environment government of Mrs Margaret Thatcher, even went so far in a UN meeting in 1982 as to say that all environmental problems in the West have been solved and they now remain mainly in the Third World.

Heseltine indeed had a point. London, for instance, has not seen for years any of those smogs it saw regularly in the

1940s and 50s, which led to thousands of deaths, and the Thames now even boasts of salmon. But Michael Heseltine, like all representatives of vested interests, was only hiding something of deep significance: the role of the Western world in destroying the Third World's environment.

Very simply speaking, the major environmental problems in the West are those arising out of waste disposal—problems of air and water pollution and of disposal of highly toxic, industrial and nuclear wastes. Though problems of acid rain have definitely increased and there does not yet seem to be any solution to the problem of toxic wastes, it is true that some cities and rivers do look cleaner.

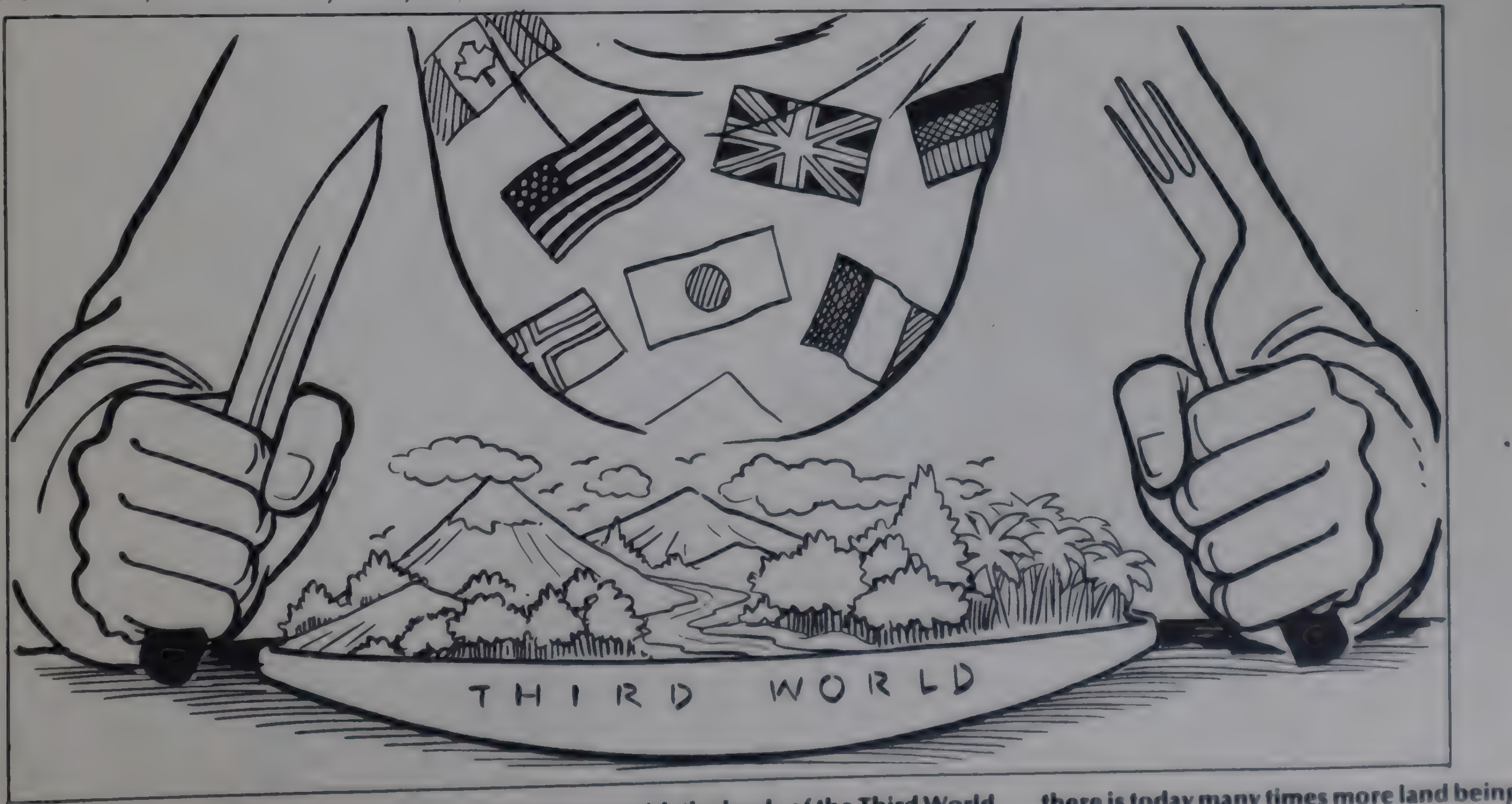
In the Third World, however, as its own industrialisation proceeds, these waste disposal problems are getting worse day by day but they are still not the major or only environmental problem. In the Third World, the major environmental problems are those which arise out of the misuse of the natural resource base: out of the misuse of soils, forests and water resources. These problems are created to a great extent because of the pressure to produce raw materials for modern industry. The Third World's environment not only provides raw materials for its own industries but also for the industries of the West.

For instance, the Japanese and Western timber industries have been the biggest source of forest destruction in Southeast Asia. Having turned countries like Thailand from net exporters into net importers of wood, Japanese companies are now turning to the last great wooded frontier of the world: the Amazon basin of South America.[10]

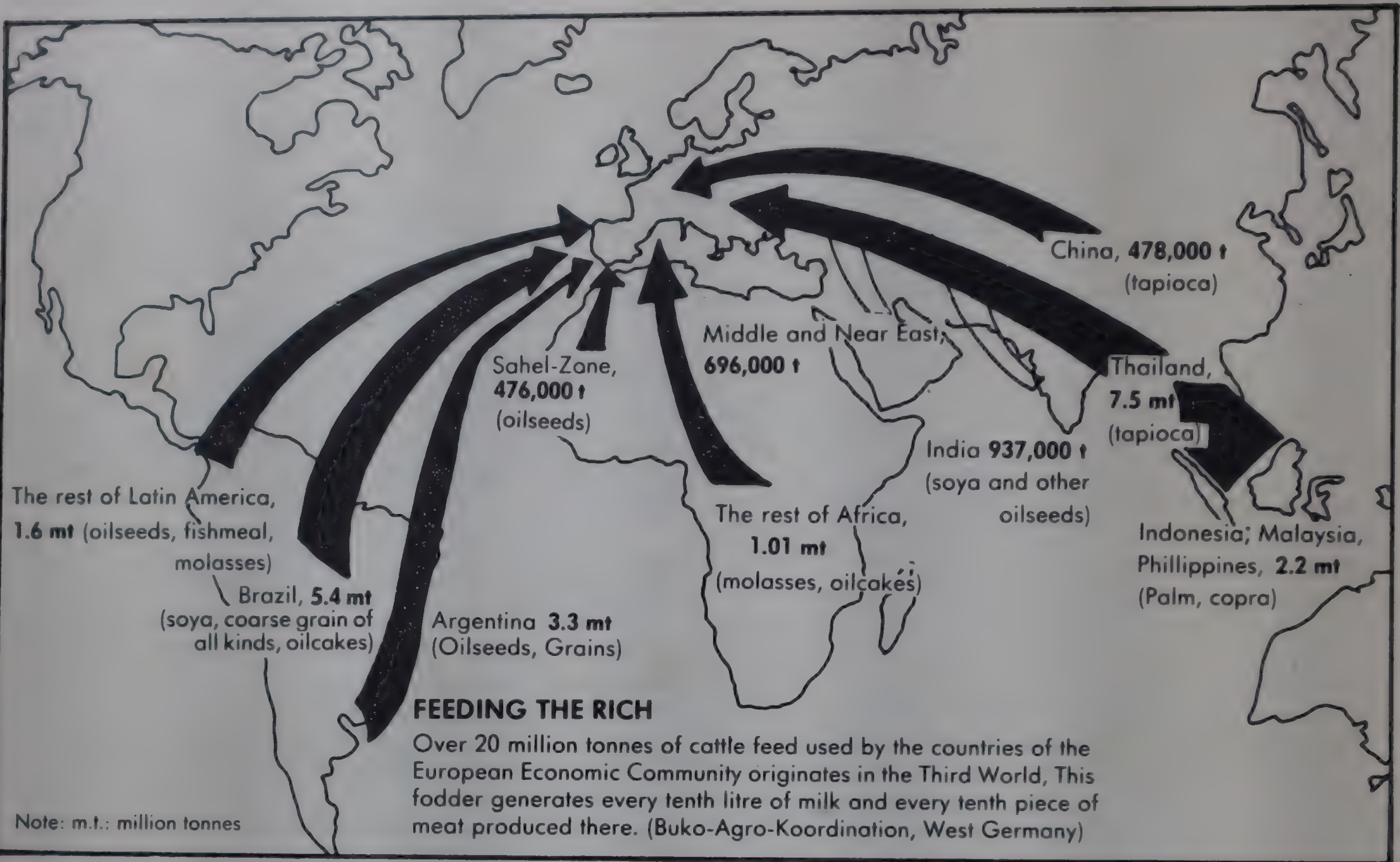
**Feeding the rich**

The food needs of the Western world have played equal havoc with the lands of the Third World. No statistics on this are available, but if someone did collect them, we will definitely find that despite the worldwide process of decolonisation, there is today many times more land being used in the developing world to meet the food and other biomass needs of the Western countries than in 1940s, before the process of decolonisation began. More than a quarter of all Central American forests have been destroyed since 1960 for cattle ranching[11]: 85 per cent to 95 per cent of the beef produced as a result has gone to the US while domestic consumption of beef in Central America has fallen dramatically. In the US this beef has been mainly used to make tinned and pet foods and cheap hamburgers because Central American beef is half the price of the grass-fed beef produced in the US. The price of the Central American beef does not represent its correct ecological cost. Cattle ranching has proved to be the worst form of land use for the fragile soils on which these tropical moist forests existed. Within five to seven years their productivity has dropped dramatically and cattle ranchers have had to move on.

The Sahelian drought of 1968-74 which grabbed world headlines and claimed the lives of approximately 100,000 nomadic people was caused by the French colonial policy to drive these countries into peanut farming to secure its own source of vegetable oils.[12] Through heavy taxation policies, the French colonial authorities forced the West African peasants to grow groundnuts at the expense of subsistence crops. Groundnut cultivation rapidly depleted the soil. It soon spread to traditionally fallow and forest zones and encroached on land previously used for grazing, upsetting the delicate balance between the farmers and the nomadic herders. The expansion of groundnuts was encouraged by artificially high prices but when US soya production began to hit the European market and vegetable oil prices began to fall, the newly independent West African countries had no alternative but to increase area under groundnut to keep up their foreign exchange reserves. As this area increased by leaps and bounds under the pressure of government policies, the nomads were slowly pushed further and further north into the desert, something for which they



**"The food needs of the Western world have played havoc with the lands of the Third World . . . there is today many times more land being used in the developing world to meet the food and other biomass needs of the Western countries than in the 1940s, before the process of decolonisation began."**



**FEEDING THE RICH**

Over 20 million tonnes of cattle feed used by the countries of the European Economic Community originates in the Third World, This fodder generates every tenth litre of milk and every tenth piece of meat produced there. (Buko-Agro-Koordination, West Germany)

Note: m.t.: million tonnes

were not prepared, their traditional relationships with the settled farmers having been totally disturbed. When the long period of drought set in and thousands of animals and human beings began to die, the nomads and their overgrazing was blamed. Nobody blamed the French or the Sahelian elite which worked hand in glove with the French.

The UN Environment Programme (UNEP) in a recent report points to the impact of the heavy debt burden of the Third World and high interest rates in the West on the environment of the Third World.[13] The debt burden and regressive terms of trade have forced many developing countries to put enormous pressure on their natural resources, sometimes even to the point of overexploitation. In 1981, for instance, it took one Latin American country 9.8 times as much beef to buy a barrel of oil as it did in 1981. At the end of 1970s, profits from the export of one tonne of bananas were enough to purchase only half the steel they would have bought at the end of the 1960s. When interest rates are high there is a tendency to discount long-term issues like environment for short-term gain. A one per cent increase in interest rates adds approximately $5 billion to the current debt burden of developing countries. To have increased its export earnings (not profits) by one billion dollars in 1981, South America as a whole would have had to increase its banana exports threefold, Ecuador threefold and Colombia ninefold, while leading cotton exporters like Egypt and Turkey would have had to double and triple their cotton exports, respectively. This would have meant bringing millions of additional hectares into production to grow these export crops. And, it can be added, this would have pushed millions of marginal peasants into marginal lands like desert fringes and steep hill slopes for their survival, leading to accelerated desertification and soil erosion.

In our own country, the first major attack on the forests of the Northeast, came with the establishment of tea plantations. Destruction of forests goes on for coffee and other export crop plantations even today. The current overfishing on India's coasts, as on the coasts of almost all Southeast Asian countries, is taking place because of the heavy demand for prawns in Western and Japanese markets. This overfishing is leading to considerable tensions between traditional fisherfolk and trawler owners, and violent encounters between the two are regularly reported.[14] Recently, Indonesia completely banned the operation of trawlers in its coastal waters and several countries, including India, have decreed regulations to prevent trawler operators from fishing in the first few kilometres from the coast. This zone is reserved for the traditional fisherfolk. But policing trawlers over such an extensive coastline is an expensive proposition and regulations are, therefore, seldom observed or enforced. The export of frog's legs to cater to the palates of Western consumers and its impact on the agricultural pest populations in affected areas is now an old story.[15] Fortunately, India not being a major export-oriented country, there are not many such examples.

But the pattern of environmental exploitation by industry that we see on the global scale simply reproduces itself on the national scale in India. What Western industry does to the Third World environment, Indian industry does to the Indian environment. Just to get an idea of how heavily dependent modern industry is on the natural environment, it may be useful to point out that nearly half the industrial output in India is accounted for by industries which can be called biomass-based industries: that is, industries like cotton textiles, rayon, paper, plywood, rubber, soap, sugar, tobacco, jute, chocolate, food processing and packaging, and so on. Each of these industries exerts an enormous pressure on the country's cultivated and forest lands. They need crop lands, they need forests, and they need energy and irrigation.

The Indian paper industry has ruthlessly destroyed the forests of India. Paper companies in Karnataka, having destroyed all the bamboo forests, are now getting their raw materials from the last major forested frontier of India: the Northeast.[16] The government's own public sector paper companies are coming up in the Northeast itself. The Andhra Pradesh government has meanwhile set its sights on the forests of Andamans and Nicobar Islands for a paper mill that it wants to build in Kakinada. A leading soap manufacturer has proposed that the Great Nicobar Islands be denuded to plant palm oil. The shortage of raw materials for wood pulp has already forced the government to liberalise import of pulp for the country's paper industry, thus adding to the pressure on the forests of other Third World countries.[17]

One lesson is, therefore, clear: the main cause of environmental destruction in the world is the demand for natural resources generated by the consumption of the rich (whether they are rich nations or rich individuals and groups within nations) and because of their gargantuan appetite, it is their wastes mainly that contribute to the global pollution load.

### The role of science and technology

If we want to see this process of 'resource colonisation' in a historical light, we can trace it back to the beginnings of the industrial revolution. The cultural diversity that existed in the world at that time was no historical accident. It was born out of the world's biological diversity and people's ability to shape a society with the use of that biological diversity. People came to adopt a lifestyle that was in harmony with the dictates of the immediate environment. Those who lived in the deserts practised nomadism and those who lived in the hills practised shifting cultivation. Houses and cities built with local materials and skills were built differently to satisfy the conditions set by the local climate.

But as modern science and technology grew, it gave people enormous power. Unfortunately the new knowledge created by scientific and technological development fell on an highly unequal world, where access to this knowledge was and still is unequal and the infrastructure to use it very uneven. The major result of scientific and technological development, embedded as it is within an unequal global society, is that it has given few people more and more power to exploit resources from further and further away. First, distant lands (distant ecosystems) were turned into colonies for resource exploitation; when decolonisation took place, multinational corporations took over the role of global resource exploitation and management within a framework of liberal international trade; and now it is the turn of such hitherto unfathomable global commons as the deep sea bed, Antarctica and space to be exploited. The UN even has a committee to discuss resource exploitation on the moon.

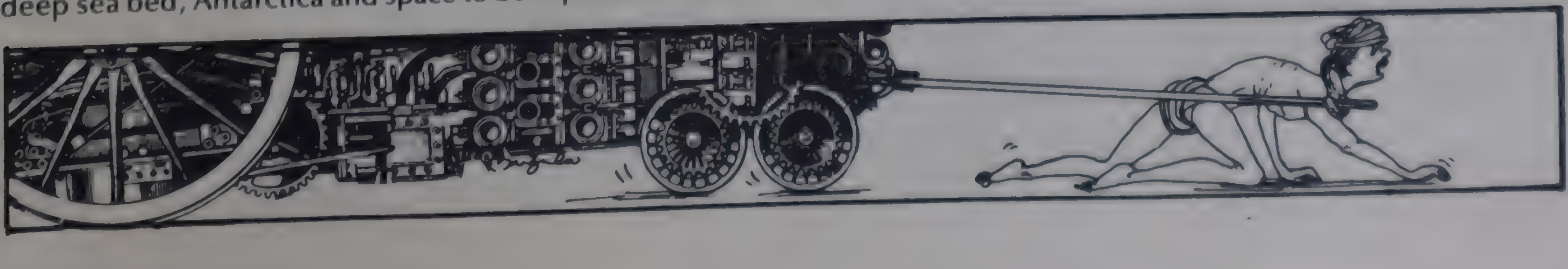
But at least on the terrestrial level, with hardly any uninhabited frontiers left, this relentless search for resources from others' ecosystems can only mean extraordinary conflict. In a more and more densely populated world, that which is a resource in a distant ecosystem for one human being is simply a resource within someone else's immediate ecosystem. If that someone's very survival is dependent on the resources of the immediate ecosystem, then there will be conflict, and resource colonisation by the powerful will end in the dispossession and impoverishment of the less powerful, in their own homeland, so to say.

These trends raise serious doubts about the sustainability of the Western industrialisation model based on global management of resources for the consumption of a few. The growth of science and technology has indeed been humankind's most magnificent achievement but definitely not the ends to which this knowledge has been used.

The most unfortunate part of this process is that we have now got a large number of consumers in the world whose consumption is highly destructive of the environment but who can't perceive this destruction psychologically. These are consumers of distant resources; those who have access to all the fruits of modern science and technology. Just imagine a resident of Delhi who uses shirts made of cotton which has been produced in a field in Maharashtra heavily sprayed with pesticides leading to multiple resistance in mosquitoes; electricity from a dam in the Himalayas that has destroyed forests and blocked migration of fish; paper produced in Madhya Pradesh by a factory that has polluted the local river and logged forests in an ever-widening circle, disrupting the life of tribals; cereals from Punjab where food is produced using a technology that drains soil fertility, and so on. It is humanly impossible for such distant consumers to appreciate what their purchasing power is doing to distant areas.

Just imagine then the situation of a Western consumer whose beef and fruits come from Latin America and Africa, peanuts from West Africa, coffee from East Africa, tea from India, prawns from Asia, and timber from all over the world. But what is probably worse, is that such consumers, no longer dependent in any crucial sense on the immediate environment for their consumption needs, slowly become oblivious of the destruction even of the immediate environment. Thus, we get a world economic system in which individuals with power have almost no interest in the fate of their environment, distant or immediate—and only a global environmental crisis, situated amidst a sea of economic poverty, has been able to evoke some concern, and we still talk of the need for environmental education in a big way.

Modern science and technology is not always used as a brutish tool by the rich and powerful to dispossess the poor.



It has also been used subtly to undermine the confidence of the poor in their own resources and resource-use patterns. Particularly if a natural resource used traditionally by people is so widely available that it just cannot be monopolised, every effort is made in the name of scientific progress to discredit that natural resource as archaic and useless. This drive to discredit a resource is undertaken to the extent that even the poor who often have no alternative except to use that resource, look forward to the day when they can do without it.

The classic example is mud. Over half the world's population lives in mud structures. Prices of cement and bricks required for modern buildings continue to rise, being extremely energy intensive, faster than the purchasing power of the world's poor. The chances of all mud dwellers ever moving from their buildings is pretty low, at least not in the next 50 years.[18]

The majority of the urban population in the Third World cannot afford even the cheapest modern housing (about US $500–$3000). In most cities of the developing world, including India, the portion of the population living in slums and squatter settlements has been rising rapidly. Unable to meet the housing needs of the relatively small urban populations, the governments of the Third World have not even dared to launch housing programmes for rural areas, where the majority of the population lives.[19]

The importance of traditional building materials to meet the needs of the world's population is ignored by housing authorities everywhere, and their use is never taught to architects or civil engineers. Mud homes are synonymous with extreme poverty, so much so that they are despised even by the poor and virtually every effort to introduce improved mud housing has failed.

While architects and civil engineers only neglect mud, medical professionals adopt an extremely hypocritical attitude towards herbal medicine. The majority of drugs available on the US market today, for instance, are plant derived (that is, the drugs were either made directly from a plant-based raw material or they were first discovered in a plant before a chemical company began to market their chemical analogues).[20] Drug companies take great care to screen herbs for pharmacological properties. The moment a useful herb is discovered, the company tries to identify the active ingredient and develop its chemical analogue. This is produced, packaged and marketed and prescribed by the medical profession.

Yet doctors dismiss herbal medicine as outright quackery and make no effort to study medical systems based on herbal medicine.[21] Drug companies make no effort to promote herbs directly. Colonial authorities in Africa had even outlawed the practice of herbal medicine. These administrations had such an effect on the colonised cultures that even after independence many African countries continued to ban the practice of folk medicine, still the only real option available to a large part of the world's people.

Even more dramatic is the process by which commercial and scientific propaganda has been used to discredit a readily available resource like breastmilk, and promote commercial substitutes.[22] Now scientific studies show the superiority of breastmilk, but it took a long campaign to formulate appropriate public policies to protect breastmilk, and even today vested interests oppose these policies.

## The poor and their environment

The above discussion makes it clear that it is the poor that are affected the most by environmental destruction. The field experience of voluntary groups confirms that eradication of poverty in a country like India is simply not possible without the rational management of our environment and that conversely environmental destruction will only intensify poverty. Environmental destruction goes hand in hand with social injustice. A major reason for this is seldom recognised. The vast majority of the rural households meet their daily household needs through biomass or biomass-related products, which are mostly collected free from the immediate environment. In short, they live within nothing other than a biomass-based, subsistence economy. Food, fuel (firewood, cowdung, crop wastes), fodder, fertiliser (organic manure, forest litter, leaf mulch), building materials (poles, thatch), herbs and clothing are all biomass products. Water is another crucial product for survival. Water is not biomass itself, but its availability is closely related to the level of biomass available in the surrounding environment. Once the forest disappears, the local pond silts up, the village well dries up, and the perennial stream gets reduced to a seasonal one. The water balance gets totally upset with the destruction of vegetation: in a monsoon climate like ours with highly uneven rainfall over the year, this means greatly increased runoff and floods during the peak water season and greatly increased drought and water scarcity in the lean dry season. There is reason to believe that the number of 'problem villages' from the point of view of availability of drinking water may be increasing.[23]

The magnitude of India's dependence on biomass for meeting crucial household needs can be appreciated by looking at the energy situation. We as Indians love to point out that India is the world's tenth largest industrial power, or something like that. But even then over 50 per cent of the fuel consumption in India is for such a fundamental survival activity as cooking.[24] In developed countries, cooking accounts for less than 10 per cent of total national fuel consumption.

Equally important for India is the fact that 90 per cent of the cooking fuel in India is biomass: that is, firewood, cowdung and crop wastes. Even urban households are heavily dependent on firewood as fuel. Few people, energy planners and government officials alike, had any idea until recently of the dimensions of the rural-urban fuelwood trade. Annual urban purchase of fuelwood are well over Rs 500 crore in India.[25] Over the last ten years, Madhya Pradesh, the only state left in the heart of India with any reasonable degree of forest cover, has emerged as a major supplier of fuelwood to the cities of north and western India. But as the state gets more and more deforested every year, fuelwood prices have been rising within Madhya Pradesh itself. Madhya Pradesh has now become India's first state and probably the world's first state too, to ban the export of firewood.[26] As a result, Delhi, which uses about Rs 15 crore worth of firewood on the retail market, is now getting less firewood, and an increasingly higher proportion from as far away as Assam, the same place from which paper mills are now getting their bamboo.

Firewood prices in Delhi are today higher than ever before and according to FAO figures are among the highest

**"Even biomass resources like thatch have become so difficult to obtain that maintenance and repair cycles of mud and thatch have increased considerably." (S.Paul/Chitrabani)**

in the world. This firewood is used by the poorest of the poor in Delhi, by construction workers and others and when the effective heat provided by firewood is compared to kerosene, because of the low efficiency chulhas in which firewood is used, firewood becomes four to five times more expensive than kerosene. LPG, incidentally, a fuel used by the richest sections of the society and supplied entirely by government sources, is the most convenient and cheapest fuel available. Which state will become the next to ban firewood exports is anyone's guess. What happens when Assam also says no?

Biomass resources not only meet crucial household needs but also provide a range of raw materials for traditional occupations and crafts and are, hence, a major source of employment: firewood and cowdung are important sources of fuel for potters; bullock carts and catamarans are made from wood; bamboo is a vital raw material for basket weavers, and so on. Traditional crafts are not just being threatened by the introduction of modern products but also by the acute shortage of biomass-based raw materials. A study from the Indian Institute of Science—the first in India on the changing market of bullock carts—reports that people in Ungra village in Karnataka can now no longer afford to buy new bullock carts with the traditional wooden wheel because wood has become extremely expensive. A recent report from the Murugappa Chettiar Research Centre from Madras reports that traditional fisherfolk now find it very difficult to make new catamarans because the special wood they use is extremely scarce and expensive.[27]

Several reports from all over the country—from Madhya Pradesh, from Maharashtra, from Tamil Nadu—portray the extreme difficulty of hundreds of thousands of basket weavers in eking out an existence because of the acute shortage of bamboo. In the Bhandara and Chandrapur district of Maharashtra, nearly 70,000 mat and basket weavers have been protesting against the discriminatory prices and small quota of bamboos given to them whereas big paper mills have been leased large bamboo forests.[28]

In Karnataka, Madhav Gadgil undertook a study of the use of the state's bamboo forests by paper mills, after a series of protests by basket weavers. Gadgil found that whereas bamboo was available to paper mills at Rs 15 a tonne it was available to basket weavers and other small bamboo users in the market at Rs 1,200 a tonne.[29] Social activists in Saharanpur have pointed out to the travails of the baan makers who have now been deprived of their earlier sources of bhabhar grass. The Uttar Pradesh Forest Development Corporation discriminates in favour of paper mills and this policy has turned thousands of these baan workers into destitutes, landless labourers and urban migrants.[30] Wood is now difficult to get for making even agricultural implements like the plough, especially wood that has been traditionally used for these implements. Few people know that one of the things that led to the Chipko movement was the anger of the local people over the forest department's refusal to provide ash wood, wood that has been traditionally used for making ploughs, whereas the forest departments happily allocated the same wood to sports goods manufacturers. Even biomass resources like thatch has become so scarce that maintenance and repair cycles of mud and thatch huts have increased considerably. A government report from Bastar, of all places, as it is still one of the heavily forested districts in the country, points out to a village where no new hut has been built over the last two decades because the entire area around the village has been deforested.[31] Traditional mud roofs have almost disappeared from many parts of the country because of the large quantities of timber needed by them. They are being replaced by tiled roofs, but baking tiles still requires large quantities of firewood.

Fodder is another vital resource that is in acute shortage. With only 2.45 per cent of the world's land mass, India supports 15 per cent of its cattle, 52 per cent of its buffaloes, and 15 per cent of its goats, and these animals play an extremely important role in the integrated system of agriculture and animal husbandry that Indian farmers practise.[32] Shortage of fodder, especially from public lands, means, as a study from the tribal areas of Gujarat shows, that poor landless households and marginal farmers do not benefit much from the milk cooperatives and animal improvement schemes in the region.[33]

In such a situation where millions of people are heavily dependent on biomass sources for their daily existence, the destruction of the environment or any policy that reduces access to biomass resources like the proposed Forest Bill and Forest Policy will have an extremely adverse impact on the daily lives of the people.[34]

## The transformation of nature

Nature is not just being destroyed. Nature is also being steadily transformed. There are two major pressures operating on the country's natural resources today. The first, generated by population growth and thus increased household demand for biomass resources, has been widely talked about. The poor often get blamed for the destruction of the environment. But the second set of pressures, generated by modernisation, industrialisation and the general penetration of the cash economy, are seldom talked about, at least in policy-making circles.

Modernisation affects nature in two ways. Firstly, it is extremely destructive of the environment in its search for cheap biomass-based raw materials and in its search for cheap opportunities for waste disposal. Unless there are strong laws which are equally strongly implemented, there is no attempt made to internalise environmental costs and both public and private industrialists prefer to pass them on to society. State governments are also happy to give away large tracts of forests for a pittance and throw water pollution control laws to the winds to get a few more factories.[35]

Secondly, modernisation is steadily transforming the very character of nature. In physical terms, the tendency is to reduce the diversity in nature and transform it into a nature that is full of high-yielding monocultures. The driving force for this transformation arises out of the commodification of nature. Whether it is a herd of cattle, a pond, a forest or an agricultural field, the attempt is to reduce diversity and promote the most high-yielding gene for maximum profit and production, the first more so in capitalist systems and the latter probably more in socialist systems. The long-term sustainability of the new system is seldom considered. The ecological role of the original nature is usually disregarded while transforming it.

In social terms, the transformation is generally away from a nature that has traditionally come to support household and community needs—and the culture that had come into existence on its basis—and towards a nature that is geared to meet urban and industrial needs, a nature that is essentially cash generating. Excellent examples of such transformations are the pine forests in place of the old oak forests in the Himalayas,[36] the teak forests in place of the sal forests in the Chotanagpur Plateau,[37] eucalyptus plantations in place of natural forests in the Western Ghats and now the proposals to grow oil palms in place of the tropical forests in the Great Nicobar Islands. Both these phenomena—the destruction of the original nature and the creation of a new nature—have been taking place simultaneously in the Indian environment and on a massive scale.

The effect of the massive environmental change taking place in India has been disastrous for the people of India especially when we realise that India is a country with an extremely high level of poverty on one hand and a reasonably high level of population density on the other. There is hardly any ecological space left in the physical environment today which is not occupied by one human group or another for its sustenance. Now, if in the name of economic development, any human activity results in the destruction of an ecological space or in its transformation which benefits the more powerful groups in society, then

inevitably those who were earlier dependent on that space will suffer (see box for European history).

Let us look at a few cases of how the destruction of nature has affected the lives of people in India. One very dramatic area where government policies have consistently increased conflict is forests. The entire tribal population, and millions of other forest dwelling people, depend on the forests for their very existence. Destruction of forests has meant the social, cultural and economic destruction of the tribal populations in particular. Beginning with the British and continuing with free India, the government has decided to control the forest resource itself, leaving little or no control in the hands of the forest dwellers.[38] Government control over forests has definitely meant a reallocation of forest resources away from the needs of local communities and into the hands of urban and industrial India. The end result is both increased social conflict and increased destruction or transformation of the ecological resource itself.

Yet another major component of the country's physical environment is grazing lands. The destruction of the grazing lands has meant enormous hardships for poor people, especially for the nomadic groups in the country. Few people know that India has nearly 200 castes engaged in pastoral nomadism, which add up to nearly 6 per cent of India's population. India is unique in the world in terms of the diversity of animals associated with pastoral nomadism. There are shepherds of camels in Rajasthan and in Gujarat, of donkeys in Maharashtra, of yaks in Ladakh, of pigs in Andhra Pradesh, and even of ducks in south India. Sheep, goats and cattle are of course the main nomadic animals.

A number of factors, including land reforms and development programmes which have promoted expansion of agriculture to marginal lands, have steadily led to an erosion of grazing lands. The Rajasthan Canal is a fine example of a government programme that has transformed extensive grazing lands into agricultural lands.[40] No effort was made by the government to ensure that the nomads who used these grazing lands earlier would benefit from the canal on a priority basis. In almost every village, the panchayat lands, traditionally used as gauchar lands, have been encroached upon by powerful interest groups and privatised. Nomadic groups have been increasingly impoverished over the last 30 years and an ever-increasing number is being forced to give up their traditional occupation to become landless labourers or urban migrants.

Riverine fisherfolk constitute another group that has suffered immensely with environmental destruction. Riverine fisheries are being seriously affected by the construction of dams which affect migratory fish and by increasing water pollution.[41] Large scale fish kills are regularly reported. Rivers have now become a resource for urban and industrial India to be used as cheap dumpyards for their wastes and all this is sanctioned in the name of economic development.

In the 158 km stretch of the Hooghly, the average yield of fish is just about a sixth in the polluted zones as compared to the unpolluted zones. Growing water pollution is thus affecting thousands of riverine fisherfolk in the country but little data is available on their plight. Inland fish production data shows a steadily rising trend but what this data reveals is less than what it masks. The increase is coming from

## Sins of the Past

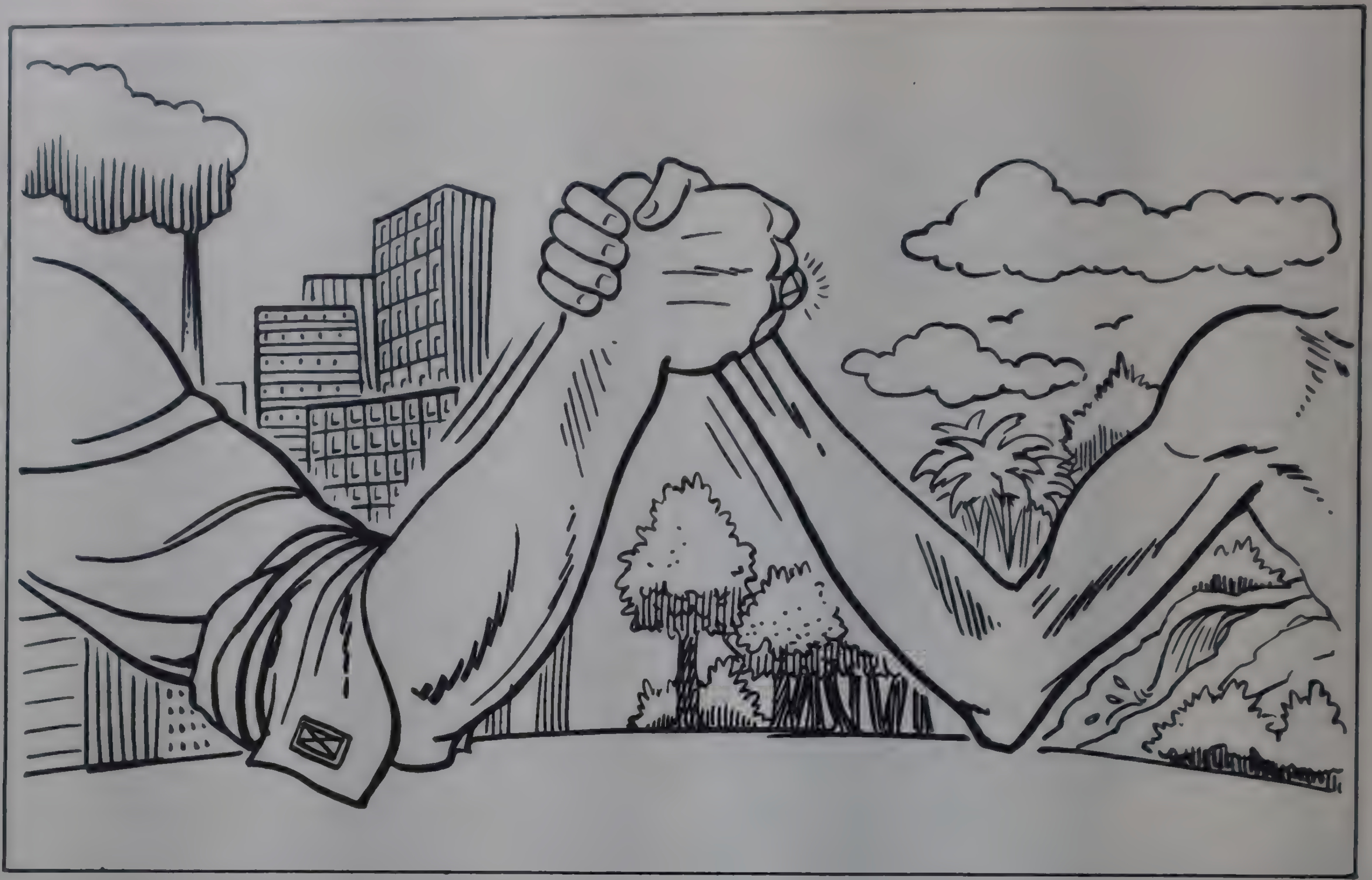
Carolyn Merchant's essay "European Ecology in Transition" describes exactly the same processes at work in England during the 16th and 17th centuries as are found in many parts of India today. These two centuries saw the market economy expanding rapidly in England and traditional relationships between the peasant community and the land breaking down. As trade quickened throughout western Europe, stimulated by the discovery and exploitation of America, production for subsistence began to be replaced by more specialised production for the market. Landlords were politically strong in England and increased their holdings by consolidating smaller plots, enclosing common lands for private use, cutting down forests for pasture and cultivation, and draining fens (marshy areas). Despite peasant rebellions in the early 16th century and the upheavals of a civil war in the mid-17th century, landlords still retained control of approximately 70 per cent of the land at the end of the 17th century.

Merchant describes in detail how the draining of the fens by English landlords, using imported Dutch hydraulic technology, destroyed both the fen ecosystem and its associated human subsistence economy. The fenland was an extensive area north of where London and Cambridge are situated today. As this land began to get transformed with the help of dikes, sluices, pumps and windmills, and the draining gentry began to acquire land to rent to tenant farmes, social struggles with the local people who depended on raising cattle and catching fish and wild fowl ensued.

Earlier the fens were well-stocked with fish and fowl that provided food for the people of the fen. As drainage projects proceeded, wildlife decreased sharply. A wildlife protection act of 1534 forbade taking the eggs of mallards, widgeon, teal and wild geese from the fens and capturing the birds themselves from June to August. Because of the toll this took of the local poor, it was repealed 16 years later. A shortage of common land soon appeared for grazing. The drier land near the village, which had in the past been reserved for meadow from which winter fodder was cut, was now also used for summer grazing. Fewer animals could be sustained through the winter.

A 17th century pamphlet claims hat these fen projects had irrevocable effects on "the faces of thousands of poor people". In several places, the fen people rioted, took up arms against the drainers, broke sluices, laid waste their lands, threw down their fences, spoiled their corn, demolished their houses, and forcibly retained possession of the land. In 1637, Charles I ordered local officials to quell fen rioters and imprison offenders. In 1638, Oliver Cromwell, 'Lord of the Fens' and leader of parliamentary forces in the ensuing Civil War, protested about the injustices done to the fen people by lords and private entrepreneurs. But even after the war (1642-1646) the drainage work was resumed and, despite setbacks, was contnued in the name of progress, commercial growth, national supremacy and the creation of employment for the impoverished fen people.

Unfortunately, few historians have attempted to document the changes that have taken place in ecosystems and their resources under the impact of human intervention. If indeed such an history of ecological change was written, there would be many valuable lessons to learn.[42]



**"there are two population groups that are putting pressure on the environment. The first and most widely talked about group is the world's poor. While its population is growing, its share of the World's resources is probably diminishing. The second human group destroying the environment is the rich. The rich are small in proportion but they consume a very large fraction of the world's resources and seem to be steadily increasing their share."**

mainly aquaculture, a technology that only those with sufficient capital and land can benefit from. Meanwhile, those poor fisherfolk who depended on access to a common property resource like a river for their livelihood suffer from its degradation.

The new, commercial nature that is being created is of little help to village communities and their daily needs. There are people's protests in many parts of the country against the conversion of oak forests into pine forests and of sal forests into teak forests. Neither pine nor teak is of any interest to local communities. In the Singhbhum area of Bihar there is even a movement to destroy the new teak forests. Equally, there is a strong protest in Karnataka against the planting of eucalyptus on farmers' fields.[43]

The planting of eucalyptus on farmers' fields and even on so-called barren fields is an excellent example of the adverse biomass conversion, harmful for the people, promoted by modernisation. What happens to the poor people when eucalyptus is planted on a farmer's field? We have a concrete example from a village in Punjab, where a rich farmer, a former governor, with over 100 hectares of land has stopped growing cotton and has switched to eucalyptus. As long as he grew cotton, enormous quantities of cotton sticks would be available for the landless labourers in the village to use as fuel. Because of the shortage of firewood, crop wastes from the landlords' fields are the major and often the only source of fuel for these poor landless villagers. Now with eucalyptus growing, their main source of fuel has dried up, putting them in a precarious position. This is a case of where afforestation has actually created a fuel famine for the neediest community.

What happens when eucalyptus is grown on a barren piece of land? Usually no land is barren unless of course it is highly eroded in which case even eucalyptus cannot be grown on it. Generally barren lands have large quantities of weeds growing on them. With the destruction of our original vegetation, a few aggressive weeds like Lantana, Parthenium and Eupatorium have literally started taking over the country. None of these weeds are palatable to animals and they therefore survive the pressure of grazing.[44]

If we look at the firewood statistics in the country, we find there is a huge gaping hole in them. The officially produced firewood does not account for even a fifth of the total estimated demand of some 130 million tonnes of firewood a year. When this was first discovered in the early 1970s, it was immediately concluded that the rural people were stealing wood from the forests on an enormous scale. Later, however, it was found that over three-quarters of the fuel used in the rural areas is in the form of twigs and little branches and there need not be any felling of trees to get this wood. But even today we do not know what vegetation is actually providing this massive quantity of twigs and branches. My guess is that weeds are now playing an extremely important role in the vital supply of cooking fuel for the poor.

A weed is defined as a plant which has no economic value but in the socio-economic reality of India, Lantana, Parthenium and Eupatorium are weeds only for revenue earning forest departments of the government. For poor households, who have no lands of their own, weeds growing on public lands are extremely useful, because of the very fact that they are not wanted by the modern sector of the economy. Once they acquire an economic value, they will go out of their hands—like bamboo, which was for long described as a weed by foresters.

Thus when a patch of barren land is planted with eucalyptus, even the weeds are no longer available to poor, landless households and their fuel crisis intensifies. Not surprisingly foresters report from all over the country, in the form of a complaint, that women even take away dry eucalyptus leaves from eucalyptus plantations for use as fuel, thus destroying, the foresters say, any chance of the leaves breaking down into humus and enriching the soil. But what else can these energy-starved women do?

What we see in India today is growing conflict over the use of natural resources and, in particular, over biomass between the two sectors of the country's economy; the cash economy (or the modern sector) on one hand and the non-monetised, biomass-based subsistence economy (the traditional sector) on the other.

As the growing stock of biomass goes down and the demand for biomass from the cash economy goes up and finally demand begins to exceed supply, pressure to exploit the remaining biomass increases enormously; biomass prices rise, and destructive processes accelerate because of market forces. Illegal timber felling is today a major activity in the country undertaken with the full support of political interests.[45] Stealing a few dozen trucks of timber is the surest and easiest way to become rich. No less a person than a chief minister—the well-known Ram Lal of Himachal Pradesh—recently had to resign because of his family's involvement in timber smuggling.

As even those forms of biomass that are used by the poor become commercialised, the access of the poor to those biomass sources gets automatically reduced because of limited purchasing power. The trend towards commercialisation of firewood has been so rapid in the last 15 years that it is now rare to find poor households using much firewood, especially in the shape of logs. Firewood is no longer a fuel of the poor but of the relatively rich.[46] The poor now subsist on qualitatively inferior sources of biomass fuels: crop wastes, weeds, twigs, cowdung and whatever organic kachra (waste) that they can find. In fact, if one goes to a village, one will see that even firewood, crop wastes and cowdung are fuels used according to the family's economic status—crop wastes usually being at the lowest end of the pecking order.

Unfortunately, several scientific agencies, thinking that "crop wastes" are actually wastes, have begun to undertake research on commercial utilisation of crop wastes. Technologies like fuel briquetting plants and small scale paper mills based on crop residues are being heavily promoted by the government. This raises prices of fuel and fodder and directly hits poor landless peasants, who now have to rely heavily on the mercy of landed farmers to allow them to take these wastes away, which they will do only as long as they are non-commercial entities for them.

In fact, in many parts of Haryana and Punjab, farmers are already insisting that crop wastes be taken by their labourers in exchange for wages. In one district of Haryana it was found that a common practice now is to let a woman pick an acre of cotton in exchange for the cotton sticks from that acre. There is no additional payment.[47] The commercialisation of biomass and its drain towards those who have the power to purchase will inevitably harm the poor and erode the non-monetised, biomass-based subsistence economy.

## Environment and women

The destruction of the environment clearly poses the biggest threat to marginal cultures and occupations like that of tribals, nomads and fisherfolk which have always been heavily dependent on their immediate environment for their survival. But the maximum impact of the destruction of biomass sources is on women. Women in all rural cultures are affected, especially women from poor landless, marginal and small farm families.[48] Seen from the point of view of these women, it can even be argued that all development is ignorant of women's needs at best, and anti-women at worst, literally designed to increase their work burden.

Given the culturally accepted division of labour within the family, the collection of household needs like fuel, fodder and water is left to women. As the environment degrades, and this collection work becomes increasingly difficult, women have to spend an extraordinary amount of time foraging for fuel, fodder and water in addition to household work, agricultural work and caring for animals. There is almost no data which shows how the time spent by women on their daily household activities is increasing and how this increase differs across different ecoclimatic zones of India. But the data that is already available on the existing work burden is downright shocking. In many parts of the country, women may have literally reached the end of their 'carrying capacities'.

The worst situation is in the arid and semi-arid parts of the country and in the hill and mountain villages. In all these areas, trees and forests have been steadily destroyed. Because of a number of factors—soil and climatic conditions, very small land holdings, lack of irrigation, etc.—the Green Revolution has also not reached these areas unlike Punjab and Haryana, where trees are few but where the Green Revolution has meant an enormous increase in biomass from croplands. As a result, there is now an acute biomass famine in these areas. In all such areas women can spend as much as five hours to six hours every day, in some households as much as 10 hours every day just collecting fuel and fodder. On the contrary, in a state like Kerala, where tropical ecoclimatic conditions permit a rich green cover, the work burden of women is much smaller—probably the least in the country. Even the minimal land reforms in which landless families have been given a tenth of an acre, has meant access to a few dozen coconut trees, which helps to provide at least half the fuel requirements.

But in the rest of the country, with deforestation, the increasing work burden on women is affecting everything else in their lives. Women do not even have time to seek health care when they are ill or take rest for a few days after a tubectomy operation. A study by the Operations Research Group in western Uttar Pradesh found that even pregnant women work for 14 hours a day. They do this almost till a few hours before the delivery and begin normal work three to four days after the birth.

Just as deforestation affects women most, laws that prevent access to biomass, like the proposed Forest Bill which provides inordinate powers to forest officials, will mean maximum oppression of women: increased demands for bribes and harrassment.

The penetration of the cash economy is also affecting the relationship between the men and women in a peculiar way and is creating a real dichotomy in their respective

**"The vast majority of the rural households meet their daily household needs through biomass or biomass-related products. Food, fuel, fodder, fertiliser, building materials and clothing are all biomass products." (UNEP)**

relationships with nature. Men have become more involved with the cash economy than women. Women continue to deal with the non-monetised, biomass-based subsistence economy of the household. Even within the same household, we can find cases of men happy to destroy nature to earn cash even though it would create greater hardships for the women in collecting daily fuel and fodder needs.

The Chipko movement has given us numerous examples of this dichotomy in male-female interests. Even the Chipko experience with afforestation confirms this dichotomy between men and women and stresses the role of women in ecological regeneration. Even though many crucial household needs could be met by rehabilitating the local village ecosystem—by planting fuel and fodder trees, for instance—the men do not show much interest in doing so. It is women who are doing most of the afforestation work organised by the Chipko movement.[49]

The new culture created by the penetration of the cash economy has slowly but steadily alienated the men psychologically from their ecosystem. Employment for them means work which can bring in the cash. Since employment can be found mainly in the city, there is mass male migration. But even when the men are in a village, a job is still something that earns cash. If such jobs are not available, they prefer to remain unemployed and do little to enrich the local ecosystem. The modern economic system is teaching them that household needs can be met only by earning cash, unlike women, who find that in their daily reality, many vital needs are still collected as a free good.[50]

There are few of those caste and class barriers in the Himalayan villages which prevent people from working together as a community. But still women continue to walk miles and miles to fetch fuel, fodder and water every day, while men do little to plant trees in the denuded areas around them. This psychological and economic marginalisation of men greatly helps to expand the availability of cheap labour to the cash economy.

It is not surprising that the eucalyptus based social forestry, trotted out to be such a great success by the World Bank and the forest departments, is all in the hands of men, all planting trees with the cash motive.[51] Other than employing women as cheap labour in nurseries, these agencies have nothing to show in terms of involvement of women—the very people who deal with fuel and fodder—and the government still calls it social forestry. But maybe this should not be surprising. Making a fast buck, even at the expense of society and ecology, is probably the most social thing that the World Bank can teach us in a cash economy.

Male migration—another major phenomenon in modern society—also seems to be increasing the work burden of women, who then have to take care not only of household needs but also have to devote more time to the family's agricultural fields. But as the time needed to collect fuel and fodder grows, agriculture must get neglected. As time for fuel and fodder collection grows and firewood becomes scarcer, the traditional practice of manuring fields will also be given up. Cowdung will be used as fuel, as in the plains, but with the lack of manuring, these fragile hill soils will be exhausted very soon. It will be a disastrous situation both for the local people and the environment. Already in Ratnagiri district, a major source of male workers for the city of Bombay, an enormous amount of cultivable land lies fallow. In this way, these women from migrant households suffer double exploitation: that of their own and of their husbands, who are not given enough of a wage to keep a household together. While the husband sweats for a pittance in the town, the wife keeps the household going in the village by collecting free goods from nature and by working harder on the family farm or as a farm labourer.

Because of the increasing incidence and intensity of floods, there has been considerable talk in recent years about integrated watershed management in the Himalayas and in the Ghats. The Himalayas are being described as one of the most threatened ecosystems in the world, which in turn determines the fate of several hundred million people in the Indo-Gangetic plains. But if any action for ecological reconstruction has to be taken in the hills, it cannot be done without the involvement of women. The census data of 1981 shows that all the districts in the country which have high rates of female work participation are situated in the Himalayas or in the Ghats. In the Himalayas a very high proportion of women workers are also classified as cultivators. Therefore, any programme which aims at ecological rehabilitation in these areas will have to involve heavily overworked women unless, of course, labour is brought into these areas from outside, which will create tensions of another kind.

Fortunately, the experience of the Chipko movement shows that women in these parts, despite their 14 hour to 16 hour back-breaking work schedule, are extremely keen to participate in such work, especially in tree planting. Once the women are organised and mobilised, the evidence is that they work with great keenness and they fight any obstacles that may be created by men, and we get as a result some of the highest tree survival rates found in afforestation efforts.[52] The biggest ally in the demand for an ecologically and socially sound nature is, therefore, womankind.

As exactly similar experiences have been noted in East and West Africa, in Kenya and in the Sahelian countries, there is every reason to believe that this differential interest in nature between men and women is cross-cultural in character. Male trees and female trees are now common jargon amongst those interested in involving communities in afforestation.

All this should not be taken to mean that poor rural households do not have any need for cash. The unfortunate thing is that much of the cash generated by the male does not get spent on household needs. A reasonable proportion of this cash gets spent on products like alcohol and tobacco and artefacts of modernisation like transistor radios.

The situation is creating a new demand on the time of poor women and in some cases is resulting in a new militancy against nature. Women now have to go out and also earn some cash. Millions of rural women today sell firewood in the towns and cities. If we look at the quantum of firewood consumed in the cities, we can say that at least 2.3 million people must be engaged in headloading — bringing wood on their heads to sell in the towns — making the firewood trade the largest employer in the commercial energy sector of the country.[53] Surveys show that selling firewood is a profession that has grown rapidly in the last 10 to 15 years with the growth in landlessness and joblessness. Most of these headloaders are women, and mostly tribal women. Selling firewood is back-breaking work and brings in extremely little money. But the women do this because they cannot rely on their men to bring any cash back home. The big advantage with headloading is that this work is generally available round the year. So when no other work is available, headloading at least provides some income.

Every headloading woman knows that the forests will be soon destroyed and even this horrible occupation will come to an end. But they are afraid that if they do not take advantage of the forest now, the foresters will soon sell it off to a contractor. The forest departments are extremely keen to get headloading banned. They have made no study of the phenomenon of headloading. They have not made any long-term plans to meet the firewood needs of the cities. They have obviously not made any effort to connect the two issues. Foresters have become environmentalists: they say that these women destroy young trees, lop trees excessively: therefore, ban them. No wonder forests are a major issue in most tribal agitations.

If a head count is taken at this stage, we will find that the destruction of the environment and its transformation is already affecting on an immediate and on a daily basis at least the following groups: artisans, nomads, tribals, fisherfolk, and women from almost all landless, marginal and small farm households. These groups add up to no less than half to three-quarters of the country's entire rural population. And unlike the situation in the West, the question of environmental destruction is not an issue related to quality of life but a question of survival.

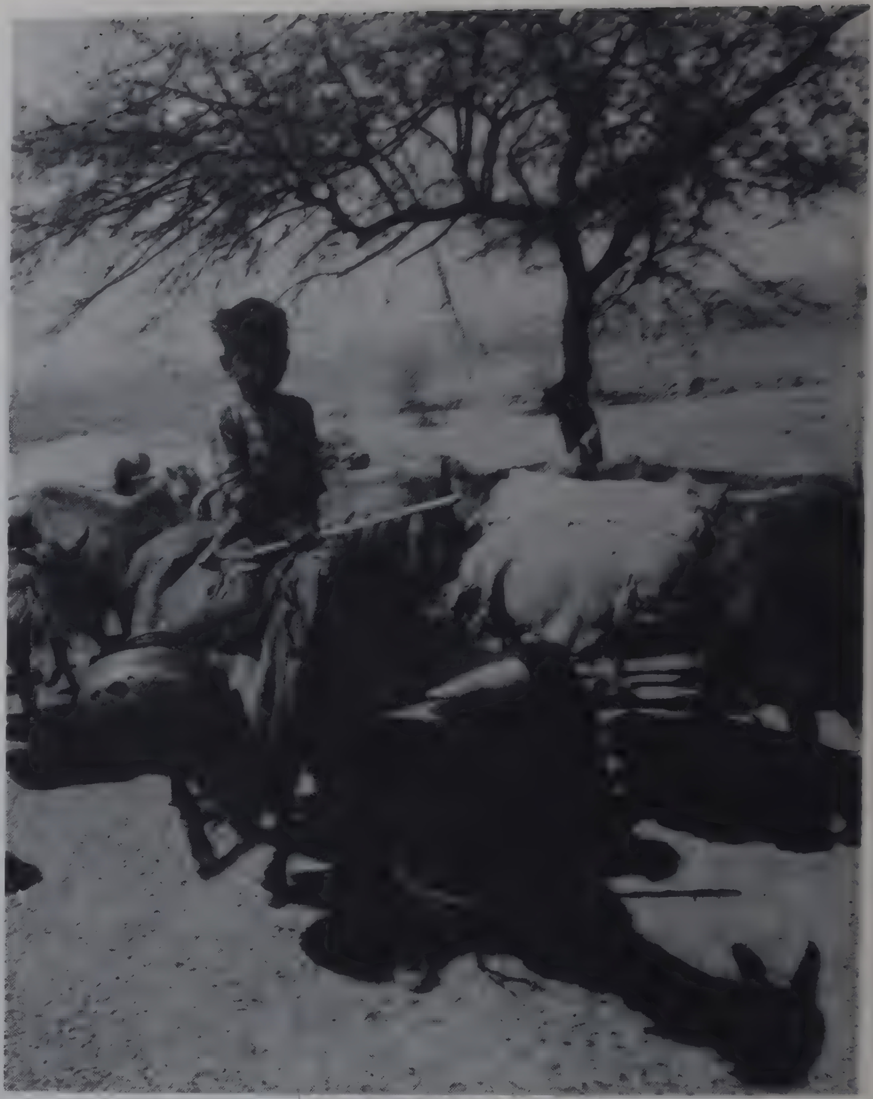
## Towards holistic management

If these are the problems, then what do we do about them? First of all, there must be much more holistic thinking regarding the management of our land and water resources. And this will not be easy, unless a determined effort is made. For all the talk about the need for a scientific temper, it must be recognised that the current methodology of scientific analysis carries within itself an extremely unscientific practice: reductionism. It is this reductionist approach that has today produced both natural and social scientists who know more and more about less and less, who know how to cure a disease but create another disease in the process. Ecology is the first scientific discipline that has actually forced people to integrate and not reduce.

This can be illustrated by describing what is happening to the three major components of our lands: forest lands, croplands and grazing lands.

The destruction of forests has a major impact on the productivity of our croplands. This happens in two ways. Soil erosion increases manifold and the soil literally gets washed away, leading to an accentuated cycle of floods and droughts. But equally important is the impact of the shortage of firewood on the productivity of croplands. When firewood becomes scarce, people begin to burn cowdung and crop wastes. In many places cowdung and crop wastes are now the major sources of cooking energy. Thus, slowly every part of the plant gets used and nothing goes back to the soil. Over a period of time, this nutrient drain affects crop productivity. Add to this the technology of the Green Revolution: the technology of growing high yielding varieties on a limited diet of chemical fertilizers like nitrogen, phosphates and potash. The total biomass production goes up and so does the drain of the nutrients from the soil. Plants need some 25-odd elements to grow, not just N, P and K.[54] They keep taking these nutrients from the soil and the more intensive the agriculture, without any manure and crop wastes going back to the soil, the faster is the nutrient drain. Today, the district of Ludhiana has the highest yields of many cereals but it also has the highest deficiencies of many micronutrients in its soil. In Punjab, many farmers have routinely begun to use zinc as a fertiliser. Soon it will be sulphur, manganese and iron deficiencies. The micronutrient fertiliser industry, already a Rs 10 crore industry, is set to become the boom industry of the future.[55] But the net result is that Indian agriculture, because of this and many other factors, most of them related to ecological factors, is showing a consistently declining trend in output when compared to the rapidly rising levels of inputs.[56]

If existing croplands and irrigation water resources are not used well, then faced with a rising population, the demand for colonisation of marginal lands for agriculture will grow. As large parts of the country have excellent soils and enormous sunlight and the only shortage is of water, government programmes have also promoted the cultivation of marginal lands, especially through spread of irrigation. Fortunately, the rate of expansion of the cropped area has now come down as compared to the 50s and 60s but enormous ecological damage has already been done. Even more than forest lands, croplands have expanded on to grazing lands. The result is that graziers have been pushed on to lesser and lesser grazing lands. This has in turn led to the overstocking of grazing lands, the destruction of their productivity and the impoverishment of the graziers in the process.[57]



**"... graziers have been pushed on to lesser and lesser and grazing lands. This has in turn led to the overstocking of grazing lands, the destruction of their productivity ..."**
**(FAO)**

The graziers have taken recourse to two strategies in such a situation. As the environment becomes more and more hostile, they get rid of the more vulnerable cattle and start keeping goats.[58] The number of goats in Rajasthan has expanded dramatically—much faster than any other livestock. Environmentalists may howl that the goat is highly destructive of the environment but it is a far better suited animal to the hostile environment that human beings are creating in Rajasthan, Gujarat and Maharashtra. It makes economic sense for the grazier to reduce risk during a period of drought, which is common in these areas.

The herders try to solve their problem in yet another way: they begin to use forests as grazing lands.[59] This infuriates foresters who see goats and cattle as the worst evil ever devised. It is true that India's forests are among the most heavily grazed in the world. But it is not true that forests disappear because of goats and sheep: they disappear only when they are chopped down and this is done usually under the aegis of the forest departments. Animals then move in to stop the regeneration of the logged forest. Animals cannot destroy a closed forest by overgrazing.

As forests are disappearing in Rajasthan and Gujarat, nomads in large numbers, from these states now enter Madhya Pradesh still a heavily forested state. The state's foresters, threatened by this invasion, banned these 'foreign' invaders by law but the Supreme Court struck

**As the environment becomes more and more hostile, they get rid of the more vulnerable cattle and start keeping goats. The number of goats in Rajasthan has expanded dramatically . . ."**
**(A.S. Kochar/WHO)**

down the ban saying that Indians cannot be restricted from going from one state to another.[60] So the inter-state movement goes on but clashes are accelerating. Madhya Pradesh's foresters killed 5,000 sheep in one extremely brutal incident on the Madhya Pradesh-Rajasthan border last year and local politicians rushed to rouse passions against the nomads, making every effort to break down the highly synergistic relationship that once prevailed between nomads and settled farmers. The nomadic animals would earlier bring manure to the fields of settled farmers. Like a walking vacuum cleaner, these animals would gather nutrients from all over and dump them on to the farmers' fields where they would rest and the nomad would even be paid for this service. But today there is open hostility.

The Madhya Pradesh forest secretary recently wrote an article in the 'Times of India' saying: 'For the love of Mike, please keep these animals out of our forests.' If only the animals could be kept out, the forests would regenerate themselves. But such despair is no answer. Animals cannot obviously be kept out without creating extraordinary conflict.

Meanwhile, however, the foresters have found an ingenous solution: plant trees like eucalyptus which cannot be a browsed by animals. Eucalyptus is loved by foresters exactly for this reason. There are many who doubt the ability of eucalyptus to produce more biomass than many indigenous species. But it is indeed ironic that when the country faces an acute fodder crisis, the forester can only plant eucalyptus and produce non-browsable biomass, doing exactly the opposite of what the people need. In fact, eucalyptus is the true weed from the point of view of the landless. It is non-browsable like all fast-spreading weeds and does not benefit the poor unless they own land.

But in this manner the cycle of destruction is complete. The forest departments have destroyed forests by selling off timber to the industrial and urban interests. The firewood shortage and the resulting soil erosion is keeping the productivity of Indian agricultural lands low. Croplands have expanded on to marginal lands and have reduced grazing lands. Animals have moved into forests and are preventing regeneration. Meanwhile, as landlessness and joblessness grow, even groups like the tribals who from times immemorial have lived in total harmony with forests are turning against forests and want to sell them off as fast as they can. All the chickens are coming home to roost.

Experts sit in grand isolation. Foresters have no interest in fuelwood or in croplands. Agricultural experts have no interest in animals or in grazing lands. Animal husbandry people never tell foresters that they must produce fodder banks.

In the life of the proverbial last man—or as I would prefer, the last person—of Gandhi, all this isolated thinking brings havoc. Life for the poor becomes terrible. Finally, even nature turns against itself. Once denuded, the high solar energy and temperature—the very factors that can bring high productivity and high prosperity—begin to bring high desiccation, erosion, destruction, and social and ecological poverty. FAO figures show that the effect of unchecked soil erosion on soil productivity is one of the highest in the world, given the ecoclimatic conditions of South and Southeast Asia.

## Population and resource constraints

India's increasing population has often been blamed for nulifying the gains made by post-independence economic development programmes and for increasing environmental destruction. Any serious discussion of the economic and environmental ill-effects of population growth must, firstly, take into account the consumption patterns that exist within society and, secondly, must be based on some understanding of the carrying capacity of India's lands. No authoritative study exists that relates all these factors to provide a composite picture.

On a global basis, at least, it is clear that there are two population groups that are putting enormous pressure on the environment. The first and most widely talked about group is of course the world's poor. It is a large fraction of the world's population. It subsists—or more accurately is being forced to subsist—on a small fraction of the world's resources. While its population is growing, its share of world resources is probably diminishing. This is leading to an *extraordinarily intensive* use of resources: heavy lopping of trees, overgrazing, cultivation of marginal lands, reduced fallow periods, etc. The environment-population literature is full of concern about how the poor are destroying the environment. This is, however, the old game of blaming the victim.

The second human group destroying the environment is of course the rich but its depredations are much less talked about. An excellent example of this hypocrisy is the much touted World Conservation Strategy prepared by the

**"Knowledge of the carrying capacity of India's lands is extremely limited ...... India is in a position to feed at least two billion more people with known technology .... Properly managed, India's lands can bloom bringing unprecedented prosperity." Paddy stocks were rotting in a government warehouse while millions go hungry. (Anil Puri/ India Today)**

International Union of Conservation of Nature, and on the basis of which the Government of India is preparing a national conservation strategy.[61] The strategy talks about the urgent need for sustainable rural development but makes no mention of the far more crucial need for sustainable urban development or of Western development.

The rich are small in proportion but they consume a very large fraction of the world's resources and seem to be steadily increasing their share. This group is no longer living on the resources of its ecosystem and depends on an *extraordinarily extensive* use of the world's natural resources. Japanese companies, for example, happily destroy one forest in Indonesia and move on to another forest in Papua New Guinea. The rich destroy the environment not only by their own consumption but also by forcing the poor into a situation where they survive only by overexploiting their environment.

Europe was the first continent to have outstripped the capacity of its ecological space to cope, both because of its growing population and its still growing consumption levels. Europeans solved the problems posed by their unprecedented breeding over the last few centuries mainly by colonisation of vast tracts of land. Between 1846 and 1930, over 50 million Europeans were exported to set up homes in North America, Latin America, Australia and South Africa. The Caucasian population of the world grew from 22 per cent of the human species in 1800 to about 35 per cent in 1930.[62] And today the situation is that even the vast colonised lands are not sufficient to meet its gigantic appetite. The Third World's population crisis today arises not because its current growth is unprecedented, but because it can neither solve its problem by spilling over into other ecosystems nor does it have the financial clout to purchase resources from other ecosystems. The Third World can survive only by finding a process of development that would allow it to accomodate its people by developing resources available within its own ecosystems. This is something that the Western development model does not know and cannot teach.

Knowledge of the carrying capacity of India's lands is extremely limited. There is no worthwhile study covering even the area of a development block, let alone a state or the whole nation, which also reveals the puerile level of the population concern in India. Fortunately, the detailed exercise carried out by FAO of the population supporting capacity of tropical lands shows that India, unlike many other countries, is in a position to feed at least two billion more people with known technology.[63] In other words, properly managed, India's lands can bloom bringing unprecedented prosperity, and population control is not a crucial issue.

But this does not mean that the population must expand to fill the ecological productivity possible, or that family planning programmes are not important. The demand for family planning should arise not out of the state's self-professed inability to cope with the growing population's needs. This should be taken more as a reflection of the population having outgrown the population supporting capacity of a system of governance rather than of the natural environment, at least in the case of India. The demand for family planning in a society ought to arise out of a respect for the woman's body, as part of a process that aims to increase women's self-assertion and assuredness and gives women the right to decide how their body will be used. Female literacy is closely related to falls in the birth rate and Kerala is a fine example of this within India itself. Probably the most important difference between Kerala and Punjab, the most prosperous state, is that while

Kerala's GNP has grown much more slowly than that of Punjab, a much larger proportion of the increase in Kerala has benefited women than in Punjab. The Kerala example shows that when women get a fair share of the wealth and services created in society, there is the likelihood of a much more healthy social and demographic development.

In other words, family planning is not a state right but a human right, especially a women's right, and the path to it should be through a healthy process of social development, with a focus on women's needs and problems and not through a technical-marketing pogramme for development and distribution of newer and newer, and usually dangerous, contraceptives.

## Improving the gross nature product

Nothing could be more important for planners and politicians today than to rebuild nature. But this can only be done if we re-establish a healthy relationship between the people and their environment. Then only a nature that is useful to the millions, not for making millions, can be re-established. Regardless of what happens in the West in the next two decades, for all its electronics revolution, its biotechnology inventions, its communications satellites, its efforts to mine the oceans and its efforts to build solar cells and windmills, and how dramatically this changes the face of the world technostructure, and regardless of how much we may want to catch up with the West in the name of modernisation or out of the sheer compulsions of geopolitics, rebuilding nature and rebuilding its relationship with the people will remain the only way to solve the problem of poverty and possibly even unemployment. With some 100 million to 150 million hectares of waste and near-wastelands and with the crying need to produce biomass, this country can never get a better opportunity to harness the power of its people to the productivity of its and, to strike at the roots of landlessness, poverty and unemployment, all at the same time.

If enough biomass was available, poverty, that is, lack of cash, as defined by economists and by the modern civilisation, will not disappear. But the rigours of poverty, the increasing susceptibility to natural emergencies like floods and droughts, and definitely the *increasing* rigours of poverty will be arrested by creating more biomass. In fact, conventional measurements of poverty based on income data or on food calories are clearly inadequate in a situation where the rest of the biomass needs are becoming increasingly difficult to meet and collecting them on a daily basis constitutes the worst—and growing—drudgery humankind, especially womankind, has ever known. These calculations are not only just inadequate but they also reflect a strong gender bias because they deal mainly with those aspects of poverty—lack of cash—that the male is generally concerned with but not with those aspects of poverty that the woman deals with—lack of fuel, fodder, water etc.

If we were to construct a concept like Gross Nature Product, we would find that for the poor it is this indicator which is many times more important than the conventional Gross National Product. In fact, we can even say that those who do not get much from the conventional GNP—the poor—are the ones who are most critically dependent on the Gross Nature Product. The Gross National Product cannot be allowed to destroy or transform the Gross Nature Product.

Just as the economists get very worried about the structure of the Gross National Product, it is equally important, if they have the poor in mind, that they get worried about the structure of the Gross Nature Product. It is not just the quantity of biomass that is important for meeting basic household needs but also its diversity: sources of biomass within any village ecosystem must be diverse enough to meet the diverse household needs of fuel, fodder, building materials and herbs, and of raw materials for artisans.

The diversity in nature has also acted as insurance during periods of emergency by reducing societal vulnerability. During periods of drought and resulting crop failures, which are recurring phenomena in many parts of India, fruits from trees, and roots, leaves and wild animals in the forests, used to become an important, alternative source of nutrition. In 1983, the tribals of Chotanagpur survived a drought not because of government assistance but despite government callousness. It is the forests which gave them their nutrition. Surviving on the forest during a drought is common in Bastar. Wild animals caught in the jungles become a significant source of food during periods of crop failure. study from Africa found that in times of drought, traditional societies had nearly 150 responses. They even fed the thatch of their huts to the goats. But in a modern village there were only two responses: pray to God (which even the Tamil Nadu government recommended during the Madras water crisis) or migrate to the towns. The combination of trees, grasses, crops, animals and ponds, which we found in almost every village was an extraordinarily interactive and resilient system to emergencies. Instead of destroying this complex and interrelated system, science must be used to build on it.

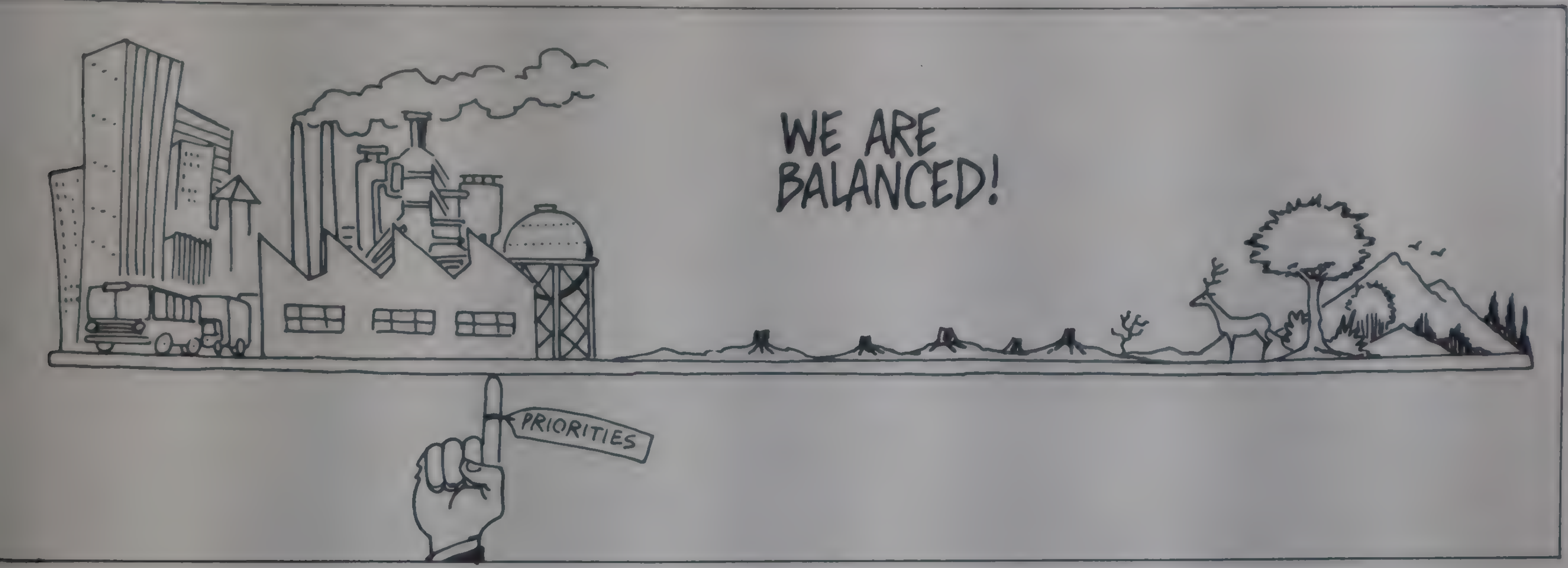
In other words, it is not enough to preserve biological diversity in just those areas of our country where the flora and fauna are genetically rich and diverse by setting up biosphere reserves and national parks, but that biological diversity must be preserved and/or recreated in every village ecosystem. Concentrating on the production of a few commodities (cereals, for instance) is totally inadequate in a society which is only partly monetarised and where the vast majority still has to depend on access to free biomass resources from the immediate environment. Every village has to become a biosphere reserve. If sufficient biomass could be generated, there would also be none of those tensions we see around nature protection areas today.[65] At a time when biomass is in acute shortage, it is obviously foolhardy to attempt such protection without massive schemes for massive biomass generation.

Understanding of the Gross Nature Product and how it is changing within the national ecological space (or shall we say, national economy) is extremely limited, despite its crucial importance for the poor. We know nothing, for instance, about the importance of so-called weeds for the poor. The reason we know so little about the Gross Nature Product is because the 'growing stock' of biomass does not get reflected in Gross National Product calculations anywhere. Therefore, whether the 'growing stock' lives or dies, exists or disappears, does not make any difference to economists. Most economists, not surprisingly have no clue of what happens to a subsistence economy when its biomass resources are affected. The growing hardships and tensions only get reflected in studies of 'political economy which record growing conflicts over land, forests, fodder, grazing lands, water sources, etc or in totally unexpected indicators like the sex ratio of the country. Just why 22 million women failed to show up in India's 1981 census is anybody's guess. Surely their extraordinary work burden, in a situation of malnutrition, must be an important factor.

It is for this reason that an indicator like Gross Nature Product, and changes in that indicator, would probably reflect far better the changing reality in the subsistence sector of a country like India. Unfortunately we do not know as yet how to construct such an indicator. But if we did, we will definitely find that while the conventional GNP has gone up, the Gross Nature Product has steadily gone down, the former acting as a parasite on the latter.

The answer to India's immediate problem of poverty lies in increasing the biomass available in nature and increasing it in a manner that access to it is ensured on an equitable basis. But giving a relevant 'green cover' to the country—the real Green Revolution—would probably require the most holistic thinking that planners, economists and scientists have ever known. The conflicts and complementarities in the existing land use patterns have to be extremely well

"Many people prefer to call the urban migrants economic refugees from the countryside. But many of them are really ecological refugees, displaced by dams, by mines, by deforestation, by destruction of grazing lands, by floods, by droughts, by urban expansion, and what not ..... no law or laws like the so-called Delhi Bills, which try to turn the incoming ecological and economic refugees into criminals, will work". (Mark Edwards Earthscan)



understood. Otherwise land-use patterns will remain as chaotic as today. Landless and poorer peasants will continue to oppose planting trees on community lands under so-called social forestry programmes because they are afraid this will take away their grazing lands while forest departments and richer peasants will only plant those trees which animals cannot touch (like eucalyptus) even though there is a stark fodder crisis all around. Nothing could take us closer to Gandhiji's concept of gram swarajya than striving to create village ecosystems which are biologically diverse and self-reliant in their local biomass needs to the maximum extent possible. This will clearly demand an extremely intensive use of our natural resoures like land and water to create a huge and diverse growing stock of biomass. Any science which teaches how to do this will truly have the right to be called a people's science—and indeed it will have to begin with the traditional knowledge of the people. Even more so, planning for the enhancement of village ecosystems will call for village-level planning with the involvement of the people—a level of decentralisation that has never been attempted either in resource planning or in resource management.

The biggest challenge, therefore, is before social workers and politicians who have to play a crucial role in ensuring that people can participate in this biomass-based development process. No biomass-based strategy can succeed without the involvement of the people, especially women, without whom this work cannot be done. If useful nature is to grow it will have to be protected and nurtured. The walls built to protect nature will be respected by the people only if they are people's walls and if the people know that what grows beyond belongs to them.

Easy availability of biomass leading to a reduction in women's work burden could create the appropriate conditions for many desirable social changes. Kerala, for instance, is often cited as an interesting case of an economically poor state moving ahead with its demographic transition. But is Kerala poor in environmental terms also.? The availability of biomass, in fact, appears to be the maximum in India and women's work burden low. This may sound an exaggerated proposition but would it be right to surmise that, among many other things, it was also the easy availability of biomass and relatively lower work burden that created the appropriate conditions for literacy programmes for women to succeed? If women in Kerala had to spend as much time as women do in large parts of Rajasthan, Uttar Pradesh and Bihar, wouldn't there have been immense male pressure to keep women working in crucial household activities and away from schools?

Immediately, at least, the country must recognise that a clear biomass policy is desperately needed, which recognises the competing uses for biomass in society, especially between biomass-based industry and poor households and sets clear priorities on the use of biomass in a situation of scarcity. The needs of the poor must be specified as a priority use of biomass in the existing situation of environmental degradation. A beginning definitely needs to be made with the proposed Forest Policy and with rural energy planning in general.[66]

If India fails to recreate nature on a massive scale in a manner that generates employment and equity, not only its villages but also its cities will become unlivable. Many people prefer to call the urban migrants economic refugees from the countryside. But to my mind many of them are really ecological refugees, displaced by dams, by mines, by deforestation, by destruction of grazing lands, by floods, by droughts, by urban expansion, and what not. We have today the world's fourth largest urban population. Before the end of the century we will be the largest. Managing this huge urban population will call for extraordinary political and managerial sagacity and altogether new approaches, something we cannot learn from the rest of the world. But one thing is definite, if the process of urbanisation continues to create the same demands on our rural environment, it will only accelerate the destruction of the rural environment and in turn make the urban environment impossible to manage. India cannot survive without a low-energy, low-resource input urbanisation. In its absence, no law or laws, like the so-called Delhi Bills,[67] which try to turn the incoming ecological and economic refugees into our cities into criminals will work. Only a holistic approach to our problems and dedicated political will to solve them will work.

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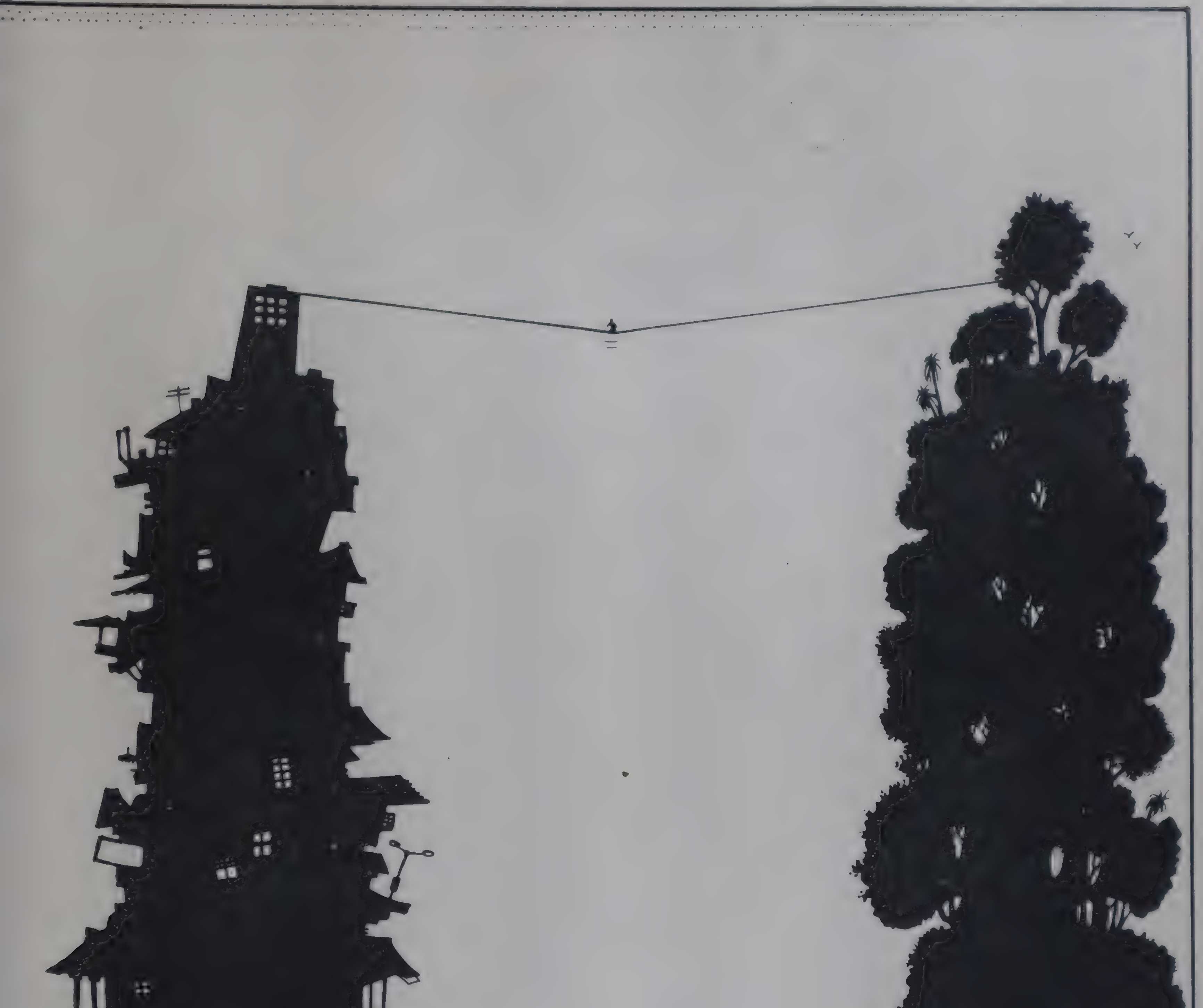

# RESOURCES

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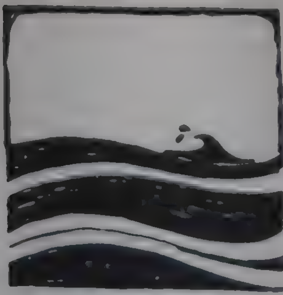

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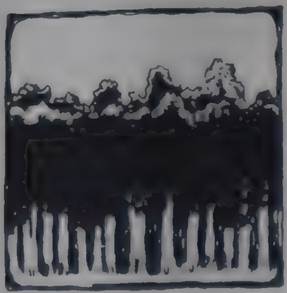
**Dead Lakes** written by Arun Bhattacharjea is based largely on a paper by Charles Elliot published in Mazingira magazine and **Fishy Story** entirely on S.R. Hiremath's paper Community Action and Environment (mimeographed). **Waste and Wetlands** relies heavily on press clippings from The Statesman; Dhrubajyoti Ghosh's Significance of Wetlands in Environmental Rescue: Lessons from Calcutta's Eastern Fringe, Department of Fisheries, Government of West Bengal; and, Brij Gopal's Ecology and Management of Freshwater Wetlands in India (mimeographed).

The box **Ganga Fisherfolk: Between Ancient Oppression and Modern Destruction** was written by Sunita Narain based on interviews with activists of the Ganga Mukti Andolan, and an article by Chandresh, Nadi per zamindari: Jail Me Machli ke bajaye Machuare, Dinman, 3–9 July 1983.

**Murky Waters** was written by Sunita Narain based on a visit to Varanasi, and interviews with groups protesting against the polution, professors at the Banaras Hindu University and citizens of Varanasi involved with the movements. Also referred to is data from the Central Water Pollution Control Board about the water quality in the river.



## FORESTS

The section on **Social Forestry** has been written by Sevanti Ninan and Anil Agarwal with the help of various World Bank and USAID documents that friends in India and abroad have been able to get for us. We have consulted the mid-term review mission reports of Gujarat, Uttar Pradesh and Madhya Pradesh social forestry projects, World Bank staff appraisal reports of Jammu and Kashmir, Haryana, West Bengal and Karnataka social forestry projects, and the project document of the USAID-supported Maharashtra social forestry scheme. It is ironic that while World Bank documents are almost impossible to obtain in India, they are easily available to researchers in USA and Europe. We have also consulted the annual reviews of World Bank financed forestry programmes prepared by the bank's staff every year. In addition, numerous articles have been published in Indian newspapers on social forestry projects. Other than the Annual Report of the Ministry of Agriculture, 1983-84, we have not been able to obtain any official review of social forestry programmes conducted by the Indian government.

The box on **Gujarat: Many Trees, Little Firewood** written by Sevanti Ninan, is based on the World Bank's mid-term review mission report; K.P. Karamchandani's detailed paper on the Gujarat social forestry programme; various papers presented by forest officials of the state; and, Peter A. Dewees' Gujarat Community Forestry Project—Wood Balance and Market Studies: A preliminary assessment, prepared by the International Institute for Environment and Development in Washington, D.C.

The box on **Tamil Nadu: Credibility Gap** by Sevanti Ninan is based on various surveys commissioned by the Social Forestry Monitoring Board of the state government and numerous press clippings.

The box on **Social Forestry: Madhya Pradesh** by Sevanti Ninan, has made use of the mid-term evaluation report of the state's social forestry project prepared by USAID. Similarly, the box on **Uttar Pradesh: Big Farmers Forestry** by Sevanti Ninan has made use of the World Bank's mid-term evaluation report.

The box **Growing Up** also by Sevanti Ninan deals with afforestation efforts by schoolchildren and is based on two articles written by Kamla Chowdhry of the Society for Promotion of Wastelands Development.

The box **With a little help from friends** by Sevanti Ninan and Anil Agarwal is based on extensive discussions that we have had with voluntary agencies on their afforestation efforts, various papers presented by them at seminars and meetings and personal correspondence. The box **Danger: Red Tape** by Kalpana Sharma is based on papers presented by the Mahithi Team and Srilata Swaminathan on their frustrating experiences with the forest bureaucracy.

Information obtained from these documents has been supplemented by extensive travel notes and personal discussions of the above authors and CSE staff members.

**The Great Eucalyptus Debate** was written by Anil Agarwal with the help of special reports prepared by Priya Deshingkar, Balraj Kumar and Sunita Narain. Several papers were referred to for the preparation of this section, notably the papers presented at the National Seminar on Eucalypts organised by the Kerala Forest Research Institute at Peechi in January, 1984, its final recommendations, and speeches made at the seminar by T.N. Khoshoo, secretary, department of environment and C.L. Bhatia, inspector-general of forests; the report of the Economic and Planning Council of Karnataka on Eucalyptus and press statements issued against it by J. Bandyopadhyay and B.V. Krishna Murti; and, the discussions and the summary record of the Workshop on Socio-Economic Aspects of Eucalyptus held by the Planning Commision in May, 1984. In addition, a number of papers and documents were referred to, namely, J.J. Dutta's Eucalypts in Madhya Pradesh; A.N. Chaturvedi's Eucalypts for Farming; V.J. Patel's A New Strategy for High Density Agro-Forestry; Some Aspects of Eucalyptus Hybrid, a collection of annotated notes on research papers on eucalyptus; G.A. Patel's Gujarat Experience of Eucalyptus; D.R. Bhumbla's Fuelwood Plantations; statements issued by Sundarlal Bahuguna and others after an on-the-spot survey of eucalyptus plantations in Hoskote taluka in Karnataka; and, Vandana Shiva and J. Bandyopadhyay's Ecological Audit of Eucalyptus in Rainfed Regions. In addition, the article has used information presented in a series of articles and counter-articles by K. Ulhas Karanth, Claude Alvares and Mahasveta Devi in various 1983 issues of Economic and Political Weekly, and various articles published by Himalaya: Man and Nature and My Forest. There are in addition numerous press clippings on this subject. Discussions with Manjunath Dutta and Hanumanthe Gowda of the Karnataka Ryota Sangha and Balraj Kumar's trip to Mallewal village in Hoshiarpur district were very helpful in the clarification of several socio-economic issues.

The section on **Government Forest Lands** was written by Anil Agarwal and it relies on the report of the Raw Materials Committee of the Development Council for Paper Pulp and Allied Industries released in 1983; several articles on the paper industry published in journals like Business India, Business World, Commerce and India Today and newspapers like the Economic Times and the Indian Express; Madhav Gadgil, S. Narendra Prasad and Rauf Ali's Forest Management and Forest Policy in India: A Critical Review, published in Social Action, Vol 33, April-June, 1983; Madhav Gadgil and S. Narendra Prasad's paper on Vanishing Bamboo Stocks published in Commerce, June 17, 1978; the Shahdol Group's Planning the Environment, January, 1981; S. Ramesh Bhatt's Problems of the Management of Bamboo Resources in Tamil Nadu published by the Bombay Natural History Society; C. T.S. Nair's Man and Forests: Coexistence or Mutual Annihilation (mimeographed); Nanubhai Amin's Afforestation on Wasteland in Gujarat (mimeographed); Shankar Ranganathan's Population: The Neglected Factor and Relevant Forestry, June 1981; and, the Recommendations of the Department of Environment regarding the revision of the National Forest Policy.

**Game, Set and Match** by Balraj Kumar is based on the discussions that took place at the National Seminar on Poplars organised by the Uttar Pradesh Forest Department in April, 1984 and **Forest Loss** on the data collected by the National Remote Sensing Agency in Hyderabad on the forest cover in India.

**The Spreading Rot** by Anil Agarwal has been written using newspaper clippings from India Today, the Indian Express, Times of India, Statesman, The Telegraph, The Hindustan Times, Economic Times and Northern India Patrika. Particularly useful was India Today's article on the ouster of former chief minister Ram Lal and Shahnaz Anklesaria's Not Seeing the Wood for Trees published in the Statesman, September 29, 1983.

**While the Nation Scounges for Wood** by Anil Agarwal is based on How many hectares per kattumaram published by the Murugappa Chettiar Research Centre, Madras, November 1983; the ASTRA report on bullock carts in Ungra published by the Indian Institute of Science, Bangalore; T. Sampath Kumar's article on Nirmal toys industry published in Khadigramodyog, Februry, 1983; Gautam Bhatia's The ugly, ordinary, mean and spiritless Indian home published in Express Magazine, April 7, 1985; Anupam Mishra and Satyendra Tripathi's The Chipko Movement published by the Gandhi Peace Foundation; and, Dilip Thakore's High noon in the match industry, Business World, April 25-May 8, 1983. The accompanying box **Tensions Grow between the Forest Bureaucracy and the Poor** is an edited version of Kobad Ghandy's article, The Bamboo War, published in the Sunday Observer, Bombay.

**Paper Tiger** by Anil Agarwal is based on articles published in Commerce, Indian Express, Economic and Political Weekly, Voluntary Action, Business India and Commerce; a paper prepared by Shekhar Singh of the Indian Institute of Public Administration, New Delhi, on the baan workers of Saharanpur; and, B.V. Krishna Murti's Ecodevelopment in Southern Mysore, published by Environmental Services Group, New Delhi. Balraj Kumar paid a special visit to Sirsa district to study the use of crop wastes.

**Forest Loss** was written by Anil Agarwal based on the data on deforestation collected by the National Remote Sensing Agency, Hyderabad.

The major documents used by Ravi Chopra for writing the section **Bastar: The Vanishing Frontier** are as follows: Bastar at a Glance—1983, released by the Statistics Bureau (Office of the Commissioner, Bastar Division), Jagdalpur, 1983; District Rural Development Agency's Integrated Rural Development Programme Annual Action-cum-Credit Plan 1983-84, Jagdalpur, 1983; A Perspective Plan (1979-1989) for Integrated Tribal Development in Bastar District, prepared by the National Council of Applied Economic Research, New Delhi; J.B. Lal's monograph Forests and Grass Lands; Bastar: Liberated or Trapped, Illustrated Weekly of ndia, August 30, 1981; Ayesha Kagal's two articles on water pollution in Bastar published in the Times of India, Sunday Review, April 11 and 18, 1982; and, various press clippings. These documents have been supplemented by the author's own notes and interviews during his trip to Bastar.

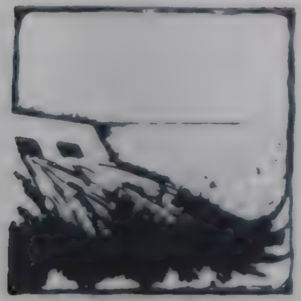
**Fell Figures** was written by Vinod Dhawan and is based on Deforestation in Himachal Pradesh, a study conducted by the Society for Participatory Research in Asia, New Delhi; **Forest Forum** on the Report of the Committee on Forest and Tribals in India, Tribal Development Division, Ministry of Home Affairs, 1982; **Ban the People** on the Report of the Committee for Review of Rights and Concessions in the Forest of India, Forestry Division, Ministry of Agriculture, March, 1984; and, **The Forest Policy: Questions Unanswered** on the National Committee on Environment Planning's recommendations regarding the revised national forest policy and Madhav Gadgil and Ramachandra Guha's joint articles in the Times of India, Two options in forest policy, September 12 and 13, 1984. Forest Forum and Ban the People were written by Sunita Narain and the Forest Policy: Questions Unanswered by Anil Agarwal.

The section on **Minor Forest Produce** was written by Walter Fernandes based on his ongoing work on tribals and forests in Orissa and Madhya Pradesh.

**Whats in a Name** was written by Sunita Narain based on interviews with Pandurang Hegde of the Appiko movement and others who have visited the area and travelled extensively with Appiko activists. Also referred to are newspaper articles and mimeographed reports on the movement.

**Islands in the Stream** was written by Sunita Narain, based almost entirely on a report prepared by S. Santhi and Sathis Chandran Nair, 'The status of Forests in Andaman, and Nicobar Islands' and on an interview with N.D. Juyal, former consultant, Planning Commission. Also referred to is C.N. McVean, Report on Land Use in the Andamans and Nicobar Islands, International Union for Conservation of Nature and Natural Resources, and newspaper clipping on plantation programmes in the islands.

The box **Commercial Connection** has been written by Sunita Narain. For information on the apple and tea industry, the papers of the National Workshop on Substitutes of Forest Timber for Packaging of Horticultural Products, Tea, Tobacco and Textile held in Vigyan Bhawan, New Delhi, July 30-31, 1983 were useful. Also referred to were articles by Prem Shankar Jha, Saving H.P.'s Forests, First Steps on a Long Road and Himachal Plans for Forestry, Times of India, September 5, 1983. Also by Prem Shankar Jha, Saving the Himalayan forests: Tackling the Long Term problems, Times of India, Septembr 12, 1983 and by Devinder Sharma, How apple is not a cash crop for H.P., Indian Express, October 9, 1983. Information on the tobacco industry's contribution to deforestation is mainly from two articles by Praful Bidwai, Virginia tobacco fast devouring A.P. forests, and Harm to Forest Avoidable, in the Times of India, 12th and 14th August 1983. Also referred to is an article by John Madeley, Curing the Tobacco: Killing the Trees, published in International Agricultural Development, May-June, 1983.



## DAMS

The section on **Dams** has been written by Ramesh Awasthi and Anil Agarwal. Comments on alternative water management strategies were given by Dunu Roy. Ramesh Awasthi travelled extensively across the country to collect information for the chapter. In addition, the following documents were consulted: various studies published by the Centre for Social Studies, Surat on villages submerged by the Navagam dam; The Untold Story of the Srisailam project, Lokayan September 1981; The Sardar Sarovar Narmada Project Studies on Ecology and Environment, M.S. University of Baroda; Kashyap Mankodi's Learning from the Ukai Experience, Centre for Social Studies, Surat; Ramchandra Singh Deo's Civilisation in a Hurry; D.R. Bhumbla's Small Reservoirs: A programme for improving rainfed agriculture, Society, for Promotion of Wastelands Development, New Delhi; David Seckler and Deep Joshi's Sukhomajri: A Rural Development Programme in India; and A.K. Roy and others; Planning the Environment, Vidushak Karkhana, November 1982. In addition, the author's referred to newspaper clipping and answers given to questions in the parliament.

The boxes **Bhatsa Backlash** and **Dam Dissent** and the section **Koel Karo Struggle'** were written by Ramesh Awasthi. For the story on Lalpur dam, Awasthi interviewed B.L. Varma of Action for Food Production, New Delhi and for Koel Karo, he visited the dam site and interviewed members of the Koel Karo Jana Sangthan and other concerned people in Ranchi.

**The Battle of Bhopalpatnam-Inchampalli** was written by Darryl D'Monte based on his visits to the dam site and interviews with concerned activists and Baba Amte.

**The Colossus of Narmada** was written by Vinod Dhawan based on various newspaper clippings; the report prepared by Rajiv Bhartari and others for the Hindu College Nature Club and Kalpvriksha entitled The Narmada Valley Project — Development or Destruction?; and Per Ljung's Planning the Narmada Basin: Development in Madhya Pradesh, Centre for Monitoring Indian Economy, April 1983.

The boxes **Silent Success** and **'Bogged Down'** were written by Darryl D'Monte; the former based on the research undertaken for his forthcoming book 'Temples or Tombs: Three Environment Controversies' and the latter based on Brijraj Singh's series of four articles on the Rajasthan Canal in The Patriot, April 9-12, 1984 and Chaitanya Kalbag's article, Mirage in the Desert published in India Today, July 31, 1983.

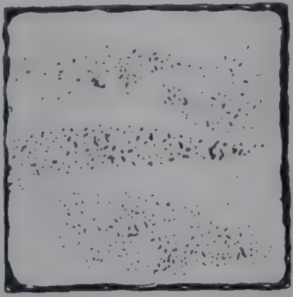
The box **Ping Pong** was written by Balraj Kumar after his trip to meet Pong dam oustees in Rajasthan.

The box **Water, Water Everywhere** was written by Anupam Mishra and **'The Maharastra Act'** by Sunita Narain based on information supplied by the Society for Participatory Research in Asia.

**Power Struggle** was written by CSE staff based on an article published in India Today, January 31, 1983 and **'Himalayan Blunders'** based on newspaper reports and information supplied by Dasohli Gram Swaraj Mandal.

**Small is Powerful** was written by Narendra Rautela and Anil Agarwal based on Rautela's trips to see operating microhydel units in Garhwal and the following documents: Summary of Deliberations and Recommendations of the Seminar on Small Hydro Stations, Central Electricity Authority and Central Board of irrigation and Power, January 1983; Development and Applications of Mini-Hydro Electric Generating Units in the Developing Countries — India, paper presented by P.K. Behl at the Workshop on the Exchange of Experience and Technology Transfer on Mini-hydro Electric Generating Units organised by UNIDO in Kathmandu in September, 1979; and, Small Hydropower Development, Renewable Sources of Energy, Volume V. UN ESCAP, 1982.

**Who needs more dams?** was written by Anil Agarwal based on Shailaja Bapat's article 'Irrigation in India — Potential and Use by Various States' published in the Economic Times January 25, 1984.



## ATMOSPHERE

The section on **Domestic Pollution** was written by Anil Agarwal. A background note was prepared by Dilip Ahuja. The section is mainly based on the following papers: Traditional Biomass Fuels and Air Pollution: A Global Review, The Rural Biomass Fuels and Air Pollution Project, Resource Systems Institute, East-West Centre, 1983, mimeographed; Jamuna Ramakrishna and Kirk R.MS Institute, East-West Centre, 1983, mimeographed; Jamuna Ramakrishna and Kirk R. Smith, Smoke from Cooking Fires: A Case for Participation of Rural Women in Development Planning, Working Paper WP-82-20, November 1982; A.L. Aggarwal, R.M. Dave and K.R. Smith, Air Pollution and Rural Biomass Fuels in Developing Countries, ASSET, Tokyo; and Kirk R. Smith, Village Cooks and Indoor Air Pollution: The Dark Side of Small is Beautiful, mimeographed.

The section on **Power Station Pollution** was written by Kalpana Sharma and Darryl D'Monte. The following documents were used: Sreekant Khandekar, The Pollution Peril, India Today, July 31, 1984; C. Sheshadri, Super Thermal Power Stations — Boon or Bane ?; Dilip Ahuja, Potential Environmental Problems due to Coal-fired Power Plants around Singrauli, TERI Discussion Paper No. 1; Environmental Issues in the Power Sector, paper presented by C.K. Varshney at a seminar organised by the Tata Energy Research Institute in April, 1984; Darryl D'Monte, Combating Pollution in MP, Business India, January 4-17, 1982; and various newspaper clipping and government documents. Kalpana Sharma supplemented these documents with her personal notes/made during her trip to Singrauli.

**An Industry Expands** was written by Anil Agarwal based on M. Vinayak's article 'Pollution Control: An industry expands' published in Business India, June 6-19, 1983.

**'Power Play'** was written by Anil Agarwal using the following references: T.N. Ninan, Groping in the Dark, India Today, July 15, 1984; Report of the Committee on Power, Ministry of Energy, 1980; R. Rajamani, Planning for Power, Financial Express, 18-19 June, 1984; and, Power Realities, Financial Express, June 19, 1984.

**'Killer Rain'** was written by Anil Agarwal based on 'Acid Rain: The Unseen Threat' by C.K. Varshney.

**'Unhealthy Bombay'** and **'Monumental Neglect'** were written by Darryl D'Monte; the former was based on the study published by the Municipal Corporation of Greater Bombay in 1984 entitled 'Bombay Air Pollution — Health Study' and the latter used material from his forthcoming book 'Temples or Tombs: Three Environmental Controversies'. The latter article also used the following references: Ravi Sharma's article on 'Saving Posterity from Modern Pollution' released by CSE and a report on Conservation of Monuments in Delhi published by the School of Planning and Architecture, New Delhi.

**'Generating a Furore'** was written by Yeshwant Shroff with the help of information supplied by Saad Ali of Bombay Environmental Action Group.

**'Wheels of Progress'** was written by Priya Deshingkar based on J.M. Dave and A.M. Khan's paper 'Transportation and Air Pollution in Delhi'.

## HABITAT

The section on **Urban Habitat** was written by Naren Panjwani based on his travel notes, interviews and the following publications: Jagmohan's Sardar Patel Memorial Lecture on urban growth; Harold Lubell's study on unemployment in Calcutta; L.K. Deshpande's study of the Bombay labour market; Andrea Menefee Singh and Alfred D'Souza's study on employment patterns in Delhi; William Rowe's Caste, Kinship and Associations and Urban India in Southall; Meera Bapat's interviews with slum dwellers in Pune; Rakesh Mohan's national survey of settlement patterns of the urban poor; and, Ujjayant Chakravorty's CSE feature Calcutta's Slum Improvement: A Myth? The report on Hyderabad's upgrading scheme is largely based on Panjwani's trip.

**The Urban Juggernaut** has been written by Arun Chaturvedi based on his CSE feature 'Misutilisation of Land: The Urban Demon'.

The boxes **Slum Sickness** and **The Ruralisation of Urban India** were written by Naren Panjwani. The latter is based on an article published by R.P. Misra and others by the same name in Urban India. **Slum City** was also written by Naren Panjwani based on an article published in Sunday Observer on Dharavi on July 8, 1984.

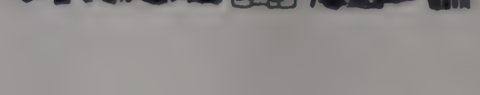
The boxes **Bypassed in Calcutta** and **Delhi's Anti-People Bills** were written by Darryl D'Monte and **The Right to Life** by Anil Agarwal. 'Bypassed in Calcutta' is based on an article by Jai Sen in the PUCL Bulletin, and 'Delhi's Anti-People Bills' is based on the papers presented at a seminar organised by the Indian Social Institute against these bills. 'The Right to Life' box is based on the PUCL pamphlet The Shunned and the Shunted: The Slum and Pavement Dwellers of Bombay released in September 1983 and a report on the Supreme Court case that appeared in Business India, December 5-18, 1983.

**A Tale of Three Cities** was written by Anil Agarwal and Smita Dutta based on newspaper clippings and the following published reports: The Boom City by Raj Chengappa, India Today, April 15, 1983; papers presented at the seminar on Bangalore as an Ecosystem organised by the Karnataka State Council for Science and Technology, June 1983; and Meera Bapat's article Hutments and City Planning published in Economic and Political Weekly. The information on Dehra Doon comes from various documents and newspaper clippings. The authors also referred to a paper prepared by Harsh Upadhyaya on Dehra Doon.

**Hill Horror,** was written by Sunita Narain based on newspaper clippings and information supplied by the Save Mahabaleshwar — Panchgani Association. The main clippings used were The Hills are Dying, Express Magazine, October 16, 1983; Vidya Subramanium, Commerce in Shangri-La, Express Magazine, February 26, 1984; A Hill Station turns Eyesore, Times of India, July 13, 1983; and Coomi Kapoor, Threatened Resort, India Today, March 15, 1984.

**High Anxiety** was written by Anil Agarwal and Smita Dutta based largely on newspaper reports. The following clippings and documents were particularly helpful: A.T. Paracer, High Rise Buildings in India, Lok Udyog, August 1975; Javed Gaya, House collapse: who will compensate the victims?, Business India, August 29-September 11, 1983; V.C. Bhaskaran, The great building tragedy, The Hindustan Times, New Delhi, October 9, 1983; and, K. Bhanumathi, High Rise Monsters, series, Deccan Herald, Bangalore, November 20, 21 and 22, 1981.

The box **Water Torture** was prepared by Ravi Chopra based on a draft supplied by PPST A. Jhunjhunwala and various newsclippings.



## PEOPLE

The section on **Population and Environment** was written by Anil Agarwal. It is based mainly on two texts: H.C. Brookfield (ed.), Population-Environment relations in Tropical Islands: the case of Eastern Fiji, MAB Technical Notes 13, UNESCO, Paris, 1980; and, Potential Population Supporting Capacities of Lands in the Developing World, FAO/UNFPA/IIASA, FAO, Rome, 1983.

The box on **The Grain Gap** has been written by Anil Agarwal based on a paper published by Narottam Shah of the Centre for Monitoring Indian Economy.

The box on **The Kerala Factor** was written by Smita Dutta based on two papers written by Moni Nag in the Economic and Political Weekly: Fertility Differential in Kerala and West Bengal: Equity-Fertility Hypothesis as Explanation, January 7, 1984, and Impact of Social and Economic Development on Mortality: Comparative Study of Kerala and West Bengal, Vol, XVIII, No 19-21.

The Section on **Caste and Environment** was written by Kalpana Sharma and Anil Agarwal based mainly on papers written by Madhav Gadgil and Kailash Malhotra. The following papers were referred to: M. Gadgil and K.C. Malhotra, Adaptive Significance of the Indian Caste System: An Ecological Perspective, Annals of Human Biology, 1983, Vol 10, No 5, p.465-478; M. Gadgil and K.C. Malhotra, Ecology of a Pastoral Caste: Gavli Dhangars of Peninsular India, Human Ecology, Vol. 10, No 1, 1982; Madhav Gadgil, The Indian Caste System as an Historical Adaptation: An Ecological Perspective, New Quest, September-October 1983; and, Madhav Gadgil and Kailash Malhotra, What price is Development?—Urbanisation threatens the lifestyle of forest communities, mimeo.

The box on **The Lost Tribes** was written by Hartman D'Souza based on his personal notes made during a trip to Rajasthan.

The box on **Conservative Community** was written by Sunita Narain based largely on Madhav Gadgil and K.C. Malhotra's The Tale of Bishnois, a mimeographed document.

**Dying Crafts** was written by Anil Agarwal. It is based on the following references: Rakesh Goyal, Forests in Palamau (Bihar): A Case Study of Manika Block, paper presented at the First Workshop on Policy Formulation for Development and the Environment, February 1984, New Delhi; Bharat Dogra and Pranay, Bans aur rassi banane wale, Navbharat Times, 12th July, 1983; Chaitanya Kalbag, Rope-making: The tightening noose, India Today, July 15, 1983; Shekhar Singh, Vested Interests, World Focus, March 1983; Pradip Kumar Bose, Traditional Craft in a Changing Society: Potters and their Craft in Gujarat, Centre for Social Studies, Surat, 1980; Anand Sagar, Clay Crafts: On the Wane, India Today, September 30, 1982; Parimal Chaudhri, Pottery: On the Wane, Business India, May 23-June 5, 1983; and, S.C. Sarker, As I see it: Travails of Traditional Craftsmen, Commerce, November 13, 1982.

The section on **Shifting Cultivators** was written by Anil Agarwal. The following documents were referred to: Forest Resources of Tropical Asia, FAO/UNEP, Rome, 1981; India and Sri Lanka: Agroforestry, FAO, Rome, 1981; Saradindu Bose and E.S. Thangam (editors), Population Data regarding Forestry Communities practising Shifting Cultivation, Report for India, 1980, FAO/UNFPA Project; Urmila Pingle, N.V. Rajareddy and Christoph von Furer-Haimendorf, Should shifting cultivation be banned?, Science Today, April 1982; and, Report of the Committee on Forests and Tribals in India, Home Ministry, New Delhi.

The box on **Tribal Trauma** was written by Srilata Swaminathan based on her personal experiences in Banswara.

The box on **Tribes of India** was written by Urmila Pingle.

The section on **Women and Natural Resources** was written by Anil Agarwal. Background notes were prepared by Kalpana Sharma and Anita Anand. Comments on the section came from Bina Agarwal and Madhu Kishwar. The section is based on the following references: ASTRA, Rural Energy Consumption Patterns: A Field Study, Indian Institute of Science, Bangalore; M.E. Khan, S.K. Ghosh Dastidar and Ratanjeet Singh, Nutrition and Health Practices among Rural Women—A Case Study of Uttar Pradesh, India, Working Paper No. 31, Operations Research Group, New Delhi; Srilata Batliwala, Women and Cooking Energy, paper presented at a seminar on Cooking Energy Systems: Problems and Opportunities, Centre for Science and Environment, New Delhi, August 1983; Towards Equality: Report of the Committee on the Status of Women in India, Ministry of Education and Social Welfare, New Delhi, December 1974; Madhura Swaminathan, A study of energy use patterns in two villages of Garhwal Himalayas, mimeographed; D. Nagbrahmam and Shreekant Sambrani, Women's Drudgery in Firewood Collection, Economic and Political Weekly, January 1-8, 1983; Bina Agarwal, Water Resource Development and Rural Women, 1981, mimeo; Vina Mazumdar, Another Development with Women: A View from Asia, Development Dialogue, Uppsala, 1982: 1-2; M.S. Swaminathan, Women's Education and Rural Prosperity, J.P. Naik Memorial Lecture, Centre for Women's Development Studies, 1982; Drought: 'God-Sent' or 'Man-made' Disaster?—Women, the worst victims, Manushi, New Delhi, July-August, 1980; J.S. Singh, Uma Pandey and A.K. Tiwari, Man and Forests: A Central Himalayan Case Study, Ambio, Stockholm, Vol XIII, No 2, 1984; S. Batliwala, Rural Energy Scarcity and Nutrition: A New Perspective, Economic and Political Weekly, February 9, 1982; S. Batliwala, Women in Poverty: The Energy, Health and Nutrition Syndrome, paper presented at a workshop on Women and Poverty at the Centre for Studies in Social Sciences, Calcutta, March 17-18, 1983; A.K.N. Reddy and Srilata Batliwala, Energy to liberate Children, Ceres, Rome, Vol 12, No 5, September-October 1979; Nirmala Murthy, Health Services not responsive to women's needs, CSE report no 108, 1984; Joyce Pettigrew, Problems concerning tubectomy operations in rural areas of Punjab, Economic and Political Weekly, June 30, 1984; Andrea Menefee Singh, Rural-Urban Migration of Women among the Urban Poor in India: Causes and Consequences, Social Action, Vol 28, October-December, 1978; Bina Agarwal, Rural Women and High Yielding Variety Rice Technology, Economic and Political Weekly, March 1984; Rajani Desai, Migrant Labour and Women: The Case of Ratnagiri, ILO, Geneva, 1982; trip notes of Balraj Kumar to Sirsa, Haryana; Andrea Menefee Singh, The Impact of Migration on Women and Family: Research, Policy and Programme Issues in Developing Countries, Social Action, Vol 30, April-June 1980; Madhu Kishwar, She works for Poor Women's Rule—An Interview with Law Janko, Manushi, June-July 1983; Sunita Auluck, Role of women in environmental conservation, Department of Environment, April 1984, mimeographed; Nirlep Malhans and Jyoti Sanghera, Apropriate for Women, Appropriated by Men: Experiment with a Gobar Gas Plant, Manushi, November 12, 1982; Anil Agarwal, Try Asking the Women First, CSE Features, 1982; Pandurang Hegde, A Handful of Grain for the Cause: Women in Appiko Movement, Manushi, May-June 1984; and, Rajiv Gupta, Fire without Smoke, CSE Report no 38, 1981.

**Ordeal for Women** is an edited version of Prabha Rani's article 'Just One More Queue—Women and Water Shortage in Tamil Nadu' published in Manushi, June-July 1983.

**Women Power** was written by Sunita Narain based on her interviews with the women from Khirakot village.

**Minefields** is an edited version of Ramnika Gupta's article 'Between Mines and Fields—Tribal Women in Bihar' published in Manushi, June-July 1983.

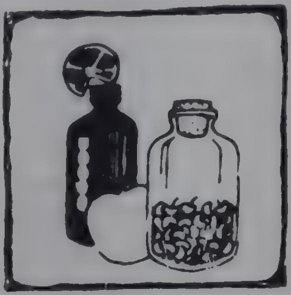
**Ecodevelopment with Women** was written by Anil Agarwal and Sunita Narain based on their trip to Chamoli.

**The New Agriculture** was written by Anil Agarwal using the following references: Towards Equality: Report of the Committee on the Status of Women in India, Ministry of Education and Social

Welfare, December 1974; 1981 census data; Bina Agarwal, Rural Women and High Yielding Rice Variety Technology, Economic and Political Weekly, March 1984; and, Govind Kelkar, The Impact of the Green Revolution on Women's Work Participation and Sex Roles, paper prepared for the ILO Tripartite Asian Regional Seminar on Rural Development and Women, Mahabaleshwar, India, April 1981.

The section on **Headloaders** was written by Anil Agarwal and Priya Deshingkar using a variety of documents and newspaper reports.

The box **Birbans—A Case Study** was written by Anil Agarwal based on B. Manipur and O.A. Mascarenhas' Barudih-Its Socio-Dynamics, Xavier Labour Relations Institute, Jamshedpur, 1982.



## HEALTH

The section on **Hazardous Products** was written by Anil Agarwal. The main references used for this section were: C.R. Krishnamurti, Toxic Chemicals, The State of India's Environment: Some Aspects, National Committee on Environmental Planning, New Delhi, May 1982; P. Ahunarai, G.K. Pandey, R.R. Khan and D.K. Biswas, Accidents due to Chemicals — An Indian Scenario, Department of Environment, New Delhi; B.B. Sundaresan, P.V.R. Subrahmanyam and A.D. Bhide, An overview of toxic and hazardous waste in India, Industry and Environment, Special Issue, No 4, 1983; S.H. Zaidi and S.J. Arcievala, Chemicals Safety Situation in Five Countries of the Southeast Asia Region, WHO, New Delhi, October 1984; and, articles published by Rune Lonngren, Lichel Mercier and Morrell Draper, and C.R. Krishnamurti in August-September 1984 issue of World Health.

**Catastrophic Pollution** was written by Anil Agarwal mainly based on Henri Smets' Compensation of Environmental Damage Caused by Non-Nuclear Industrial Activities, Environment Directorate, OECD, Paris, 1984.

**Banned Pesticides** was written by Sunita Narain. The main references used for this box were a three part article by Praful Bidwai, Times of India, December, 1982; David Bull, Pesticides and the Third World Poor, Social Action, Indian Social Institute, April-June, 1983; Kunwar Jalees, Pesticides for Survival, Yojana, March 1-15, 1984; R.C. Kalra and R.P. Chawla, Occurrence of DDT and BHC residues in Human Milk in India, Department of Entomology, Punjab Agriculture University, Ludhiana, 1980. Also important references were B. Vasantharaj David (Ed.), Indian Pesticides Industry: Facts and Figures, Vishwas publiction, 1981, and the Consolidated List of Products whose Consumption and/or Sale have been Banned, Withdrawn, Severely Restricted or not Approved by Government, prepared by the United Nations Secretariat in response to General Assembly resolution 37/137, December 1983.

**Other Bhopals** was written by Anil Agarwal based on a variety of newspaper clippings.

The section on the **Bhopal Disaster** was written by Anil Agarwal and is based largely on personal interviews and newspaper reports. All the boxes in the section have also been written by Anil Agarwal except **Deadly Environment** which has been written by Darryl D'Monte. Among the documents and articles that have been consulted for writing this section are: Sharad Sapara, Bhopal—A Report, UNICEF, December 1984, New Delhi; D. Banerji, An Epidemiological and Sociological Study of the Bhopal Tragedy, Jawaharlal Nehru University, New Delhi, February 1985; Rajesh Tandon, Third Degree Survey in Bhopal, Society for Participatory Research in Asia, New Delhi, Februrary 1985; Eklavya, Bhopal: A People's View of Death, their right to know and live, Bhopal, December 1984; Delhi Science Forum, The Bhopal Tragedy: Looking Beyond, Report of the Delhi Science Forum Team's Visit to Bhopal, New Delhi, December 1984; Final Report of the Operational Safety Survey of the Bhopal plant conducted druing May, 1982 and communicated to the Bhopal plant by the Union Carbide Corporation headquarters; Action Plan developed in Bhopal to correct the deficiencies pointed out in the safety survey and communicated to UCC by the Bhopal plant; Progress Report on the Operational Safety Survey Action Plant for Bhopal Plant communicated by the Bhopal management to UCC in June, 1984; the final report of the Operational Safety/Health Survey of the Institute MIC II Unit conducted in USA and communicated to the management in September, 1984; Union Carbide Corporation, Bhopal Methyl Isocyanate Incident Investigation Team Report, Danbury, March, 1985; ICMR Report on Current Status (first nine days) of Bhopal Tragedy and Programme of Research; Neil Andersson et al, The Bhopal Eye, The Lancet, December 22/29, 1984; IPCS-IRPTC Information Sheet on Methyl Isocyanate, January 1985; Dinesh Mohan, Bhopal: Suffering and Medicines, Mainstream, February 16, 1985; press releases of the Indian Council of Medical Research; V. Ramalingaswami, Medical Research Problems in Bhopal, mimeo; S. Sriramachari, Pathology and Clinical Toxicology of the Bhopal Disaster, mimeo; Medical Relief and Research in Bhopal: The Realities and Recommendations, Medico Friend Circle, Bangalore; Rani Bang, Effects of the Bhopal Disaster on the Women's Health: An Epidemic of Gynaecological Diseases, mimeo; Nagrik Rahat aur Punarvas Committtee, Medical Survey on Bhopal Gas Victimes between 104 to 109 days after exposure to MIC gas, Bhopal, May 1985; Union Carbide, Methyl Isocyanate, F-41443A-7/76; Zahreeli Gas Kand Sangharsh Morcha, An Open Letter to Dr. S. Varadarajan, December 1984, mimeo; Tapan K. Bose, Treatment of Gas Victims: Incompetence or Operation Cover Up?, December 1984, mimeo; Arun Subramaniam, The catastrophe at Bhopal, Business India, December 17-30, 1984; Ivan Fera, The Day After, Illustrated Weekly of India, December 30, 1984; Sreekant Khandekar and Suman Dubey, Bhopal; City of Death, India Today, December 31, 1984; Stuart Diamond, The Bhopal Disaster: How it Happened, The New York Times, January 28, 1985; Indira Jaising, A Court Too Far, Illustrated Weekly of India, May 5, 1985; Parisar, Lessons of Bhopal: An Environmental Response, Pune; The Guardian, Bhopal: the balance sheet of death, London, December 10, 1984; New Scientist, Home truths about Bhopal, London, December 13, 1984; Indian Council of Agricultural Research, The Bhopal Disaster: Effect of MIC gas on Crops, Animals and Fish, New Delhi; Central Board for the Prevention and Control of Water Pollution, A Report on the Environmental Damage due to lethal chemical catastrophe in Bhopal: A Study on the Vegetation and Soil (Biota) Survey from December 13-17, 1984, New Delhi.

The box **Carbide's DoubleStandards** is based on a note prepared by Barry Castleman. The box **Killer Company** is based on information collected by The Highlanders in the US. **One Down, More to Go** was written by Anil Agarwal based on the following reports: Umesh Anand, Big Units violating Pollution Act, The Telegraph, Calcutta, 17 April, 1985; 109 'hazardous factories' in Delhi inspected, The Statesman, New Delhi, 2 February, 1985; Feroze R. Chandra, Chemical Scare Season, The Herald Review, 14 April 1985; N. Radhakrishnan, Are These Companies Safe?, Bombay, Bombay, 7-21 April 1985; and, Duleep Singh: People should not Panic, The Sunday Observer, Bombay, 7 April, 1985.

The section on **Occupational Hazards** was written by Darryl D'Monte, largely using a pamphlet on occupational hazards by Bharat Dogra, published in 1985 by the BUILD Documentation Centre in Bombay. Annual reports of the National Institute of Occupational Health (NIOH) in Ahmedabad contained much information, though the names of the companies surveyed were not disclosed. Surveys of the Central Labour Institute (CLI) in Bombay were referred in to many newspaper articles, as were findings of the Industrial Toxicological Research Centre (ITRC) in Lucknow. The Society for

Participatory Research in Asia (PRIA), based in New Delhi, has done a great deal of work on occupational health and conducted a workshop on Worker Awareness & Occupational Health in January 1984 in Bombay. Much of the material in this chapter is contained in papers submitted to this workshop. The Centre for Education and Documentation (CED) in Bombay has also brought out a pamphlet on occupational health.

On the pencil slate units of Mandsaur, the NIOH conducted a survey in 1981. A useful article is "The Deadly Dust: Silicosis Strikes in the Slate Pencil Industry", Business India, March 15-28, 1982. A paper on "Slate Pencil Workers of Mandsaur" was presented at the PRIA Workshop and contains a list of workers who have died on silicosis. S. Chakrapani, of the Association for Voluntary Action (AVA), in Delhi has compiled material on Mandsaur.

On asbestosis, PRIA has a paper titled "Asbestos: The Dust That Kills" and CED has a pamphlet with the same title. Articles include "Killer Asbestos", Business India, January 17-30, 1983; "Way to Dusty Death, Debashish Chatterjee, Probe, June 1982; "Asbestos Pollution: Workers' Nightmare", India Today, April 16-30, 1981; "Asbestos' Kiss of Death", Subhash J. Rele, The Daily, March 1, 1983, "The Asbestos Connection", J. Kumar, Science Today, July 1982; "Killer Asbestos", Subash J. Rele, Industrial Times, February 6-19, 1984; "Tribals Face Asbestos and Cement Dust Hazards", PUCL Bulletin, June 1983; "Andheri Death Trap" (Champion Asbestos Co.), Uma Keni, The Daily, February 5, 1984; "The Asbestos Syndrome", Sankar Ray, The Telegraph, November 17, 1982; "Double Standards: Asbestos in India", Barry Castleman, New Scientist, February 26, 1981; "Asbestos Plant Threatens a village in India", Bob Wyrick, Newsday, December 16, 1981; and "Birlas Fatten on Asbestos while Tribals die of Cancer", New Age, Oct 18, 1981. Besides, the NIOH has published "Environmental cum Medical Surveillance in the Asbestos Textile Industry", in its Annual Report, 1980.

On byssinosis, a common textile industry ailment, ITRC in March 1982 has brought out a report, "Occupational Health Aspects of Textile and Allied Industries", which contains an overview with bibliography. Dr J.R. Parikh of NIOH has also presented a paper on the textile industry's health problems.

Miners and other workers in related industries suffer from pneumoconiosis. S.K. Chatterjee from the NIOH has a paper on pneumoconiosis in Indian Journal of Tuberculosis, Vol XXV, No. 1. Reports on miners have appeared in India Today, "Criminal Neglect", Farzand Ahmed, October 15, 1982, and in Economic and Political Weekly (EPW), "Sub-human Conditions at Jhagrakhand", A.S., June 5, 1982. The Department of Environment has a report of the "Environmental Impact of Mining". Bharat Dogra's pamphlet is very informative on this disease as well.

The chemical industry has a wide range of health hazards, which have been dealt with in many journals. A general report is: "Cancer-causing Chemicals", Subhash J. Rele, Daily, June 8, 1983; on the specific problem of lead poissning, Bharat Bhushan has an article in Business India, "Lead Workers: Poisoning Their Bones", December 5-18, 1983 and S. Chakravorti and S. Bhar have written about "The Lead Hazard" in Science Today, June 1982. The Industrial Psychology division of CLI has conducted a field study titled: "Psychological Impairment to Workers exposed to Lead" in 1980. More specifically, NIOH, in its 1980 Annual Report, has a report on "Health Hazards in Pesticides Formulators Exposed to Phorate, an Organophosphate Insecticide". Vijay Kanhere submitted a paper on "Hazards in Pharmaceutical Industry" for the PRIA Workshop. One article on Hindustan Antibiotics appeared in Blitz, May 3, 1980; "HAL-mark of Dugged Disease", by Devendra Mohan.

"Birla Gas" — about the Gwalior Rayons unit in Nagda, Madhya Pradesh — was put together basically from the study by Padmanabhan V.T., a researcher from Jawaharlal Nehru University, titled: "The Gas Chamber on the Chambal" and published by PUCL-Madhya Pradesh in June 1983. Dr H.S. Brar et al of CLI conducted a survey "Occupational Health Studies in the Staple Fibre Plant of Gwalior Rayon" in August 1983. Padmanabhan issued a critique of this, titled "How Not to Conduct a Medico-Environmental Study", which he circulated to interested organisations and individuals. He also co-authored an article, "Nagda's Deadly Gas", in Sunday, June 19, 1983, with Masoodul Haq. Gwalior Rayon reponded these charges in Sunday, August 28–September 3, 1983. The pamphlet and subsequent press items created a fierce controversy, as is clear from a New Age heading — "Birla Mill Poisons Whole Town in MP" (July 17, 1983). The Nagda factory manager replied with "No Health Hazard from GRASIM" in Economic Times, August 18, 1983. Padmanabhan queried their viewpoint in the same newspaper on August 31: "Is there no Health Hazard from GRASIM?" The controversy continued with India Today reporting "Riding the Storm" on July 15 and Onlooker dealt with the response to Sunday's article, "The 'Sunday' of Silk and Rayon", September 8-22, 1983.

On accidents at work — in factories and farms — Bharat Dogra's pamphlet contains a good overview. He has also written two articles, "Shopfloor Accidents: Statistics Show the Tip of an Iceberg" and "Death Traps Called Mines" in Business Standard, February 7 & 12 1983. He contributed an article to Economic Scene titled "Industrial Accidents: A Dead Letter Law" in April 1982, and "The Hazards of Working" to Express Magazine, October 17, 1982. Other articles include "Workplace Accidents are Increasing" and "Recast Safety Legislation" by R.R. Nair and P.R. Surendranath respectively, in Science Today, September 1982. On coal mines, India Today carried "Bihar Coal Mines: Criminal Neglect", by Farzand Ahmed, October 15, 1982.

In Sunday Observer, Ashok Kumar Singh, also from Patna, wrote "Violation of Safety Rules Caused Coal mines Disaster" — on the Topa accident — on August 17, 1982. More generally, H. Kusumakar of Times of India reported "Poor Mining Safety Standards in India", February 3, 1984; Economic Times blamed the public sector Coal India Limited: "CIL lags in coal Mine Safety Matters", August 2, 1983. Damodar Gupta wrote "Accidents in Coal Mine on the Rise" in Statesman, July 8, 1982. Economic Times carried an editorial, "Mines sans Safety", July 20, 1982. K.V. Subramanyam wrote "Indian Coal Mines: Graveyard of Miners", Economic and Political Weekly (EPW), August 6, 1977. Arun Sinha reported on the Sudamdih mine disaster in the same magazine on October 9, 1976. It also carried an article on "Managerial Irresponsibility" of mines. Yet another EPW article dealt with "Slaughter of Mines and Miners", October 9, 1982. Bharat Dogra reported in EPW that "Labour's Plight Continues After Nationalisation" while Rajiv Kumar wrote "Nationalisation by Default: The Case of Coal in India" in the same journal, April 25, 1981. In Business India, Sagar Dhara wrote about "Managerial Morass in Singareni Collieries", December 6-19. 1982. A long and detailed article by Kalyan Roy appeared in Patriot: "It's Safety Last in Coal Mines", February 14, 1984, while EPW carried an evocative article on "Singhbhum: A Countryside Slowly Dying", Mahasveta Devi, March 5, 1983.

Quarries are another source of occupational hazards, even though on a much smaller scale than coal mines. Bharat Dogra wrote "Quarry Workers Need Protection" in Deccan Herald, March 25, 1983. Ghanshyam Pardesi reported on "The Death Trap in the Hills" in Telegraph, July 19, 1982. On the Almora mines, Sevanti Ninan in Indian Express reported "A Boom Becomes a Bane" February 13, 1984. Quarry owners sought to extricate themselves from the scope of laws, as is evident from the Financial Express reporting "Faridabad Mine Owners quash Supreme Court Directives", April 1, 1984.

Not much material is available on the problems of noise and psychological stresss of workers in factories. Dr S.H. Clerk has presented a paper on "Behavioural Toxicology — A New Frontier Area of Occupational Medicine" at the Annual Conference of the Indian Association of Occupational health at Madras in February 1984. Subhash J. Rele, who has written prolifically on workers' health problems, has dealt with how "Stress Strikes Factory Workers", Daily, October 3, 1983. The CLI has a study on "Psychological Impairment of Workers Exposed to Lead", 1980.

Farm accidents have been much less written about than industrial hazards. Bharat Dogra has dealt with them extensively in his pamphlet. On the problems of farmers who harm themselves with pesticides they apply, Radhakrishna Rao has written "Pesticides Handle with Care", January 22, 1984.

The legal aspects of occupational health have been covered in a paper by J.T. Matheikal, while another was presented at the PRIA workshop. The CED Health Cell has a pamphlet titled "Health and the Work Place", May 1983.

On the role of trade unions, many of the articles listed in the asbestosis section refer to the reluctance of workers' organisations to fight for "quality of workplace" issues in addition to wage demands, as also how things are beginning to change. At the PRIA Workshop, which was specifically held to see how workers could get more involved in these issues, a progress report was presented on how unions in Bombay, Kanpur and other cities were beginning to educate themselves and fight for better working conditions. Articles include "RCF Workers suffer Lung Damage", Times of India, September 3, 1983 and "Safety be Damned" by Uma Keni, Daily, December 8, 1983.

The box **United They Stand** was written by Darryl D'Monte using N.K. Singh, "Rajahara Massacre", EPW, June 11, 1977 and "Dalli-Rajahara Mines: Victory for Workers", EPW, July 9, 1977. Smitu Kothari and Neerja Chowdhury have written an article called "Trade Union for Social Change" in Janata, May Day 1981.

The box on **Child Labours** was written by Darryl D'Monte. An overview of the problem is contained in Madhavrao Scindia's article in Hindustan Times, titled "Children in Hazardous Jobs", August 25, 1983. Most of the references are to the condition of children working in the Sivakasi match factories: "Five-year-olds Working in Inhuman Conditions", Hindu, April 4, 1980; "Exploiting the young", Smitu Kothari, India Today, January 15, 1983; and, "The Match Industry in Sivakasi: A Case Study of Technology, Working Conditions and Self Exployment", T.K. Moulik and P. Purushottam, EPW, May 1982. PRIA has a study on child labour in Sivakasi, which was reprinted in PUCL Bulletin, February 1983. The plight of children in other industries is mentioned in "Beedi Workers: In the Twilight Zone", Farzand Ahmed, India Today, November 15, 1983; "Plight of Agate Workers in Gujarat", S.H. Clerk et al, Science Today, December 1982 and "Geometrical and Engineering Art Instrument Workers of Roorkee, Saharanpur District, UP: A Situation Report" by Association for Voluntary Action.

The boxes **Women at Work, Staple of Death** and **Predatory Plant** were also written by Darryl D'Monte using references quoted above.

The box **TB—An Occupational Health Hazard** was written by Mona Daswani using the following references: Tuberculosis in Profile, World Health, January 1982 10,000 TB Deaths in City Every Year, Free Press Journal, 3rd June 1983; What everybody should know about Tuberculosis, World Health, January 1982; K. Styblo, TB cases over the last 30 years, Economic Times, 22nd May 1983; Tuberculosis Prevention Trial, Trial of BCG vaccines in South India for Tuberculosis Prevention, Indian Journal of Medical Research, 70, p. 349-363, 1979; Fox, W., Whither short-course chemotherapy, Bulletin of the International Union Against Tuberculosis, 56, p. 3-4, 1981; Sutherland, I., The epidemiology of Tuberculosis—Is prevention better than cure, Bulletin of the International Union Against Tuberculosis, 56, p.3-4, 1981; Tuberculosis Control, Report of a Joint WHO/IUAT Study Group, Technical Report Series No. 671, World Health Organisation, Geneva, 1982; H. Mahler, Defeat TB Now and Forever, World Health, January 1982; WHO Expert Committee on Tuberculosis, Technical Report Series No. 552, World Health Organisation, Geneva, 1974; and, A.K. Chakraborty, Communicable Disease Control, All India Institute of Hygiene and Public Health, Calcutta, 1980.

The box **Fatal Accidents** is based on information extracted from Sagar Dhara, Bhopal can happen again, The Indian Express, December 23, 1984.

The section on **Mosquito-borne Diseases** was written by Anil Agarwal. Notes on Malaria are derived from V.P. Sharma et al, Studies on the True Incidence of Malaria in Kharkoda (District Sonepat, Haryana) and Kichha (District Nainital, U.P.) Primary Health Centres Indian Journal of Malariology, June 1983; D.S. Choudhury et al, Resurgence of Malaria in Gadarpur PHC, district Nainital, Uttar Pradesh, Indian Journal of Malariology, June 1983; R.K. Chandrahas and V.P. Sharma, Malaria Epidemic in Shahjahanpur, Indian Journal of Malariology, December 1983; D.S. Choudhry et al, Response of *P. falciparum* to chloroquine in Delhi, Sonepat district of Haryana and Terai region of Uttar Pradesh, Indian Journal of Malariology, June 1983; and, V.P. Sharma and H.C. Uprety, Preliminary Studies on Irrigation Malaria, Indian Journal of Malariology, December 1982. The information on Japanese Encephalitis was culled from the papers presented at the National Conference on Japanese Encephalitis organised by the Indian Council of Medical Research (ICMR), November 1982 and the Annual Reports of the Ministry of Health and Family Welfare. The information of dengue has come from various issues of Dengue Newsletter, published by WHO; Shekhar Gupta, Viral Fever: Running High, India Today, November 15, 1983; interviews with WHO and NICD officials; and, H.C. Uprety et al, Mosquito breeding survey in Urban Delhi, Indian Journal of Malariology, June 1983. The notes for the Alternative Control came from Annual Reports of the Vector Control Research Centre and Demonstration of malaria control by alternate strategy in Nadiad villages (Kheda district, Gujarat), Malaria Research Centre, New Delhi.

The box **Prescription for Greed** was written by Ulhas Jajoo and edited by Kalpana Sharma. Several newspaper and magazine articles were used to write the article. Interviews were also conducted with Dr. S.S. Gothoskar, Drug Controller of India and Dr Mira Shiva of Voluntary Health Association of India. The box **Goitre** was written by Priya Deshingkar using the following documents: The National Goitre Control Programme: A blueprint for its intensification, Nutrition Foundation of India, New Delhi, 1983; C.S. Pandav and N. Kochupillai, Endemic Goitre in India: Prevalence, etiology, attendant disabilities and control measures, Indian Journal of Pediatrics, Vol 50, No 397, 1982; N. Kochupillai and C.S. Pandav, How not to control goitre: some lessons that could lead to a national policy in India, Futures, New Delhi, 1982; Iodine prohylaxis and endemic goitre, Indian Journal of Pediatrics, Vol 49, No 401, 1982; C.S. Pandav et al, Endemic Goitre in Delhi, Indian Journal of Medical Research, July 1980; National Seminar on Iodine Deficiency Disorders, ICMR Bulletin, November 1983; and, Shekhar Gupta, Iodine Deficiency: Retarded Development, India Today, February 29, 1984.

The box **Lathyrism: Symptoms of a Lame Government** was written by Priya Deshingkar based largely on information and comments from Jyoti Prakash. The following documents were also referred to: M.P. Dwivedi, Should Khesari Dal continue to cripple?, Science Today, May 1983; Jill Rutter and Stephen Percy, The pulse that maims, New Scientist, 23 August 1984; The Lathyrism Problem: Current Status and New Dimensions, Nutrition Foundation of India, New Delhi, 1983; Kamala S. Jaya Rao, Kissa Khesari Ka, Medico Friend Circle Bulletin, December 1977; the series of four articles by Prabhash Joshi in the Indian Express entitled "The All Seeing Blind Eye"; Farmers defy ban on Khesari Crop, Northern India Patrika, November 3, 1983; Briefing on Lathyrism, Jyoti Prakash, mimeo; and Matra ki pati rakhanhar, Jyoti Prakash, mimeo. The box **Fatal Felling** is based on several newspaper reports; Annual Reports of National Institute of Virology, Pune; and F.M. Rodrigues, Epidemiology of arboviral infections in India, Oration on the Dr. M.K. Seshadri Prize for 1982.

The two boxes **While Thousands Die . . . . . and . . . . . There is Instant Therapy** were written by Sevanti Ninan and Priya Deshingkar respectvely mainly using newspaper clippings.

**Folk Tales** was written by Dhruv Mankad.

## ENERGY

The section on **Cooking Energy: Firewood in the Cities** was written by Anil Agarwal and Bhubanesh Bhatt. The report is based on investigations in Delhi and various towns in Madhya Pradesh. The following documents were used for reference: Report of the Working Group on Energy Policy, Planning Commission, New Delhi, 1979; Domestic Energy Survey with special reference to Kerosene, National Council for Applied Economic Research, New Delhi; A.K.N. Reddy and B. Sudhakar Reddy, "Energy in a Stratified Society—A case study of firewood in Bangalore," Indian Institute of Science, Bangalore; Report of the Fuel Policy Committee, Planning Commission, 1974; K.P. Sagreiya, Forests Under Our Democracy, Indian Forester, November, 1979; K.P. Sagreiya, Forest Nistar—Problem of Madhya Pradesh, Indian Journal of Forestry, December 1979; K.P. Sagreiya, Cancerous Forest Nistar of Madhya Pradesh, Indian Journal of Forestry, Vol 4, No 1, 1981; K.P. Sagreiya, Deforestation: Stop Malpractices or Perish, M.P. Chronicle, July 13, 1979; and, Forest guards armed with special power, M.P. Chronicle, Raipur, December 17, 1982. Data on Madhya Pradesh forests was supplied by the state forest department. Data on firewood arrivals at Tughlaqabad was supplied by the Head Goods Clerk at the railway siding.

The **Urban Cowdung Network** was written by Balraj Kumar and Anil Agarwal based on investigations in Delhi and Agra. **Fuel Shock** was written by Anil Agarwal.

The section on **Animal Energy** written by Anil Agarwal and relies on the following resources: various papers written by Dr N.S. Ramaswamy of the Indian Institute of Management at Bangalore; the report of the National Commission on Agriculture; Socio-Economic Survey of Animal Carts, National Council of Applied Economic Research, Vol 1 and 2, New Delhi, mimeo; and, a study prepared by the Institute of Science, Bangalore on use of bullock carts in Ungra village. The boxes **Turning Cartwheels** and **Cart Power** were also written by Anil Agarwal. The latter is based on the NCAER's Socio-Economic Survey of Animal Carts.

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The section on **People Vs Sanctuaries** was written by Darryl D'Monte based on his visits to Bandhavgarh, Kanha and Bharatpur nature reserves and the following references: "Project Tiger Breeds Maneaters", Ajoy Bose, Sunday Observer, July 17, 1983 and Bittu Sahgal's reply, "Tigers are not for Stalking", July 24; "If Nature does not Survive, Neither will Man", Bittu Sahgal, Express Magazine, Oct 10, 1982; "Big Cats bulging out of Reserves", Darryl D'Monte, Illustrated Weekly, August 1, 1982; "Tigers Versus People", Sumi Krishna Chauhan, Earthscan, London, 1981; and, "The prerogative of man alone", Lokayan Bulletin.

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The two boxes **While Firing takes place in Bharatpur . . . . .** and **. . . . Resentment festers in the Valley of Flowers** were written by Bhubanesh Bhatt based on his visits to these areas. For the Bharatpur article, the author also relied on the report of the Kalpavriksh team sent to investigate the Bharatpur firing on 7th November, 1982; An Ecological Study of Keoladeo National Park, Bharatpur, Rajasthan, prepared by second year students of Master's degree course in landscape architecture, School of Planning and Architecture, New Delhi; and, Harsh Vardhan, Birds Or People?—A Case Study of Keoladeo Ghana National Park, Bharatpur, paper presented at the First National Environment Congress, New Delhi, December, 1982. **Kill the Tigers** was written by Sunita Narain.

**Extent of Nature Protection in India** was written by Anil Agarwal based on 1982 United Nations List of National Parks and Protected Areas, IUCN, Gland, Switzerland, 1982; and Jeremy Harrison, Kenton Miller and Jeffrey McNeely, The World Coverage of Protected Areas: Development Goals and Environmental Needs, Ambio, Vol XI, November 5, 1982.

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## AGENTS OF CHANGE

The section on **Government** was written by Anil Agarwal with the help of notes prepared by Arun Bhattacharjea. The section is based entirely on the comments received from the respondents listed.

The section on **Voluntary Action** was written by Anil Agarwal. A background note was prepared by Thomas Mathew and detailed comments were provided by Dunu Roy. The following references were used for writing the section: Harsh Sethi, Groups in a New Politics of Transformation, Economic and Political Weekly, February 18, 1984; D.L. Sheth, Grass-roots Initiatives in India, Economic and Political Weekly, February 11, 1984; Rajni Kothari, The Non-Party Political Process, Economic and Political Weekly, February 4, 1984; Rajni Kothari, Grassroots, Seminar, January 1984; Bunker Roy, Voluntarism and the 7th Plan, The Indian Express, New Delhi, August 17, 1984; Samar Singh, Theme Paper on India's Action Plan for Wildlife Conservation and the Role of Voluntary Bodies, paper presented at Bombay Natural History Society seminar on Conservation in Developing Countries—Problems and Prospects, December 1983; Report of the Conference of Non-Governmental Organisations Working on Environmental Protection, Environmental Services Group, New Delhi, March 1982; and, Sevanti Ninan and Kalpana Sharma, Poser for Voluntarism, The Indian Express, New Delhi, November 24, 1984.

The box **March of Hope** was written by Sunita Narain based on her discussions with Sunderlal Bahuguna and the various articles written by him on his Kashmir to Kohima walk. The box **Teaching the Environment** was written by Priya Deshingkar and was edited by Anil Agarwal. It relies heavily on personal interviews and information supplied by the various groups mentioned in the report.

The box **Powerful Knowledge** was written by Rajesh Tandon based on his personal travels and on the work of the Society for Participatory Research in Asia.

The section on **Legislation** was written by K. Ramakrishna.

**Public interest litigation** was written by Anil Agarwal based on newspaper clippings and articles published in various journals like the Public Interest Law Reporter published from New Delhi.

**Industry Folly** was written by Arun Bhattacharjea after discussions with officials in several industry associations and chambers of commerce. The following documents were referred to while writing the box: T.N. Khoshoo, Water Quality Management in India: Retrospect and Prospect, paper presented at the Seminar on Strategy and Technology for Water Quality Management, Indian Institute of Technology, Bombay, January, 1983; K.P. Nyati, Financial Implications of Industrial Pollution, paper presented at the COSIDICI seminar on Control of Industrial Pollution and Environmental Preservation, New Delhi, October 1984; Digvijay Sinh, Presidential Address, ibid.; papers presented at the National Conference on Environment Preservation and Pollution Control, Federation of Indian Chambers of Commerce and Industry, New Delhi, March 1984; and, Nilay Chaudhri, Industrial Pollution Control: Constraints and Conflicts, Yojana, New Delhi, March 16-31, 1984.

**The Doon Order** is an edited version of the Supreme Court judgement delivered in the Doon Valley Limestone Quarries case.

**The Right to Know** was written by Darryl D'Monte based on his experiences while writing his forthcoming book Temples or Tombs: Three Environment Controversies. He also referred to V.R. Krishna Iyer's article in Mainstream on the right to know.

# The Second Statement of Shared Concern

In the last three years—since many of us signed the first statement of shared concern—environmental awareness has grown dramatically in India. Its most noteworthy aspect, however, is that it has become increasingly humanised. The growing understanding of the importance of the natural environment and its complex linkages with culture, the economy and society, has helped to put the human being, particularly the last human being that Gandhiji always talked about, at the centre of the environmental concern. And this has brought the environmental concern itself right to centre of older concerns like poverty, unemployment, inequality and oppression.

Yet, little of practical note has happened in these years that can give us the confidence to say that the trend towards environmental destruction has been arrested. On the contrary, as this report amply documents, environmental degradation continues unabated.

The Bhopal disaster has stunned those responsible for pollution control, and put fear in the hearts of millions of industrial workers and people living near factories. But Bhopal is not the only disaster. Subtle and invisible processes continue to undermine human and natural resource base. Thousands of workers in factories and fields all across the country are maimed and killed every year. Satellite data has confirmed that India is indeed losing more than a million hectares of forests every year, something that forest departments have consistently and perversely sought to deny. All our hill and mountain ecosystems, the cradles of our life-giving rivers, are deteriorating rapidly. Even in heavy rainfall areas where forests should be in full bloom, the land is becoming a barren desert. Every day thousands of hectares of India's once-rich biosphere slide into a vast wasteland; the only difference in three years is that today the word 'wasteland' has become a part of official vocabulary. These wastelands cover no less than one-third to one-half of India's land mass. Meanwhile, the quality of life in towns and cities is degenerating rapidly. Environmental degradation threatens every Indian today.

The creation of wastelands has hit every rural and urban household. Even bare necessities for survival like fuel, fodder and water are now so difficult to obtain that women and children have to spend extraordinary amounts of time scrounging for them. When life becomes impossible within the rural ecosystem, because of growing floods, droughts, deforestation, soil erosion or because of declining soil productivity, people simply give up and join the stream of urban migrants, leading to what urban planners call 'unplanned urban growth'.

The process of transforming India into a wasteland, which began under the British rule, has continued under the post-independence governments. The most brutal assault has been on the country's common property resources, on its grazing lands, forests, rivers, ponds, lakes, coastal zones and increasingly on the atmosphere. The use of these common property resources has been organised and encouraged by the state in a manner that has led to their relentless degradation and destruction. And sanction for this destructive exploitation has been obtained by the state in the name of 'economic advancement' and 'scientific management'.

Nature can never be managed well unless the people closest to it are involved in its management and a healthy relationship is established between nature, society and culture. Common natural resources were earlier regulated through diverse, decentralised, community control systems. But the state's policy of converting common property resources into government property resources has put them under the control of centralised bureaucracies, who in turn have put them at the service of the more powerful. Today, with no participation of the common people in the management of local resources, even the poor have become so marginalised and alienated from their environment that they are ready to discount their future and sell away the remaining natural resources for a pittance.

Indian villages have traditionally been integrated agrosylvopastoral entities, with grazing lands, agricultural fields, forests and groves, and water sources like ponds, wells and tanks. The state's development programmes have torn asunder this integrated character of the villages. The state has rarely implemented plans to manage and enrich entire village ecosystems.

The crying need, is to redefine the role of the state. Instead of trying to play the role of the enabler, and doing it efficiently, many official agencies also want to play the role of the producer. Forest bureaucracies, for instance, are entrenched in their belief that they can grow trees. Just imagine what would have happened if the agriculture department, which today largely plays the role of the enabler through its research and extension, was also to assume the responsibility for growing crops! Famine would probably stalk the country every year.

The process of state control over natural resources that started with the period of colonialism must be rolled back. The earlier community control systems that regulated the use of common natural resources were often unjust and needed restructuring. Given the changed socio-economic circumstances and greater pressure on natural resources, new community control systems have to be established that are more highly integrated, scientifically sophisticated, equitable and sustainable. This is the biggest challenge before India's political system—not just the politicians and their parties, but also citizens and social activists. In the last decade or so, voluntary agencies and people's movements—like the Chipko Andolan in Garhwal, the Bhoomi Sena in Maharashtra or the Chattisgarh Mines Shramik Sangh in Madhya Pradesh, to name some—have consistently shown that despite all odds, this kind of social restructuring is possible.

There is no reason to believe, as this report documents, that India's population has outstripped the capacity of the country's environment to yield its biomass needs. True, the productivity of our basic natural resources like land and water will have to be increased substantially. But sustainable increases will be possible only under a system of participatory management and control. Every planner and politician must remember that the environment is not a fixed asset. In fact, India's resource-illiterate planners have steadily turned it into a wasting asset with their development programmes and with each passing day, its population supporting capacity decreases instead of increasing. India can beat the problem of poverty, unemployment, drudgery and oppression only if the country learns to manage its natural resource base in an equitable and ecologically sound way. But equally, if poverty, unemployment and inequality are not removed, it will be impossible to save the environment.

All this poses serious questions for our leadership, and opportunities, too. No other activity can simultaneously provide more employment today and attack the problems of poverty, drudgery and landlessness, than programmes to regenerate the country's ecological infrastructure. But emphasising and implementing these programmes will require a vision that is sadly lacking in our leaders. And yet facing up to the environmental challenge — the challenge of equitable and sustainable development — could unite the entire country at this time of strife and violence.

There is no doubt that international technological pressures will test our leadership severely. A major and extremely rapid technological transformation is taking place in the advanced industrial countries, with simultaneous developments in microelectronics, biotechnologies, ocean engineering technologies, communications technologies, renewable energy systems and various other areas. These technological changes will not only bring about profound changes in the entire technostructure of the industrially advanced countries before the end of this century, but they will also have deep ramifications for the rest of the world. In the developing world, where development has seldom meant more than a mad race to catch up with the West, these technological changes will pose serious problems. If catching up with the West needed a major commitment in the 1960s and 1970s, it will require the total commitment of all our national resources in the 1980s and 1990s.

This will raise serious questions of choice. Do we develop our science to stay in the technological race, to enter the 21st century on the terms of the world technological powers? Or do we develop our own science focussing on our land and water resources, on our forests and grazing lands, and on removing the growing environmental imbalances that threaten the very survival of millions of our countryfolk?

The question clearly is: what sort of development do we want? World geopolitics may demand that we follow the 'technological imperative'. Justice demands that we follow the 'national imperative'. India's leadership has little choice. And this choice will have to be made consciously by the country's political system—and not be left to scientists and other experts.

Ironically, the most dramatic failure is in an area where 'modern' science and technology have been applied the most, the urban system. Even though India will largely remain a rural country, it will possess the world's largest urban population by the turn of the century. Managing these large urban systems will pose colossal problems. Already the political system is buckling under the size of the urban system and the speed with which it is growing. India's premier city, Calcutta became unmanageable during the 1960s and 1970s. Bombay is rapidly becoming so in the 1980s. And before the end of the century, it will be the turn of Madras and Delhi. Many lesser cities like Kanpur died a long time ago. And almost nobody pays any attention to the hundreds of small and medium towns that dot the country. The quality of urban life is declining everywhere and in every area: slums are growing, housing problems are increasing, transport problems are becoming unmanageable, water is scarce and undrinkable, insanitary conditions are proliferating, and the air is becoming unbreathable.

Planners and politicians often like to use the phrase 'unplanned urban growth'. But this is a misrepresentation of facts. Urban-led development has always been a basic feature of planning in India. The rural development strategy has not been to develop rural areas *per se*, to meet the basic needs of the rural poor in particular. But the strategy has mainly been to 'develop' the rural areas by putting their resources at the dictates of the urban markets and by transforming the rural environment itself into mass monocultures of marketable commodities. In this sense, much of rural development has simply been an extension of urban development. And within the urban system we have completely and blindly followed the extremely high cost and resource-intensive Western model. The result is on one hand, an exploding urban system, which despite disproportionate investments, is bursting at its seams, and, on the other, a badly mauled and ravaged rural system, whose productivity is declining every day, and which keeps pushing more and more people into an increasingly chaotic urban system.

If this growing rot has to be stemmed, an alternative pattern of development has to be found urgently both for our towns and villages. Urban and rural development have to occur in a symbiotic manner. Such a process will require planning for more self-sustaining urban areas and the enrichment of the rural environment to meet the rural population's diverse biomass needs for food, fuel, fodder, soil enrichment, building materials, agricultural implements and artisans' raw materials. Planning for rural development must, therefore, be redefined to mean planning for integrated rural ecosystems.

The creation of integrated rural ecosystems will call for an extremely sensitive use of science and technology. It will call for the development of a peoples' science that harmonises the principles of traditional knowledge with modern science to serve the complex human needs in a sustainable manner. Most of today's scientists have little to offer towards these goals. Their experience is limited to simple monocultures, whether in farming, in forestry, in fisheries or in animal husbandry. And their science has proved too rudimentary and simplistic for managing complex ecosystems.

This scenario definitely does not mean that India ought to turn its back to global technological advancement. But its imagination and its ingenuity will lie in making appropriate choices. We don't have to be swept off our feet by the glamour of modern artefacts; we have to use our intelligence to choose and to match our technological capabilities to real needs.

It is possible to use the principles of materials science and structural engineering to construct sturdy, comfortable and aesthetic mud homes. As discussed in this report, of all the building materials available in India, mud can make the maximum contribution towards providing decent housing for all. Again, India's planners do not have to design cities for motorised private vehicles which pollute the air, contribute to urban sprawl, make us more dependent on fossil fuels and make the transport system less accessible to the urban poor. It is possible to plan for an urban transport system combining private bicycles—still the most accessible and non-polluting form of transport—with a highly efficient, modern and sophisticated public transport system. The list of feasible and equitable innovations is endless.

All this requires a clear vision, an imaginative and honest political system, in which elections are fought without black money, contractors and land speculators are put under control, the industrialist who pollutes is prosecuted, and so on. This country never had a greater challenge before it and never a more urgent need to restore ethical values in its social and political life. The land can be greened and the environment improved, but only if the people who control the socio-political system can learn to control their greed.

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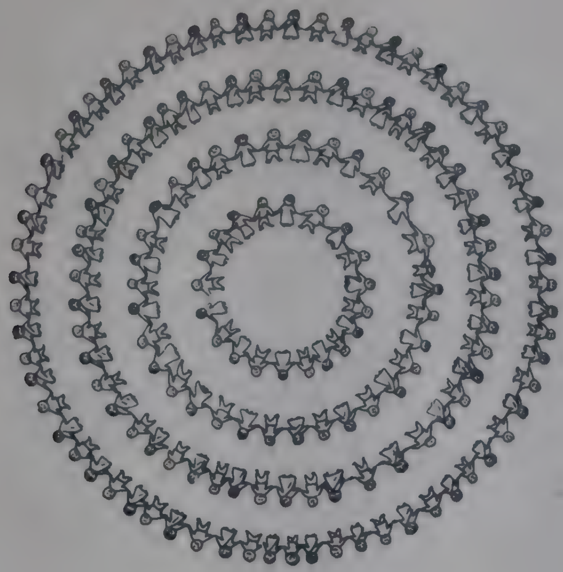

Every year the government gives its version of the state of the nation: its economy, its industry and its environment. There are few authoritative non-governmental publications which assess the state of our nation. "The State of India's Environment" is a self-financed Citizens' report. It is the product of a cooperative effort of numerous people, who have assisted in its preparation by contributing written material, ideas and criticism.

**We invite you to join this citizens' network.**

You can send us information on environmental changes occurring in your area and how you think they affect the lives of the people who live there.

Of great interest to us and readers of this Report would be news of citizens' initiatives to tackle the problems of environmental degradation.

If you are a professional, we would like to receive copies of articles or papers that you have published on environmental issues.

We would also like to know if you want to be actively involved in consciousness-raising efforts and campaigns to protect our environment. We could at least put you in touch with interested voluntary agencies.

We will be happy to put your names on our mailing list and send you announcements of forthcoming publications and other literature available from CSE. Send us also names of other people who you know are interested.

So, before you forget, dash off a letter to:

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